

SECTION 024119 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.

- B. Related Requirements:

- 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 3. Section 017300 "Execution" for cutting and patching procedures.
 - 4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 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.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

- 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

- B. Schedule of Selective Demolition Activities: Indicate the following:

- 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

- D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 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. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: Present in buildings and structures to be selectively demolished. 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.
- 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.

1.9 COORDINATION

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

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. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

- C. Perform an engineering survey 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.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 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. Arrange to shut off utilities with utility companies.
 - 2. 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.
 - 3. 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - c. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - d. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.3 PROTECTION

- A. 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.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- 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. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. 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.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 5. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 7. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- 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. 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.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings. Do not use methods requiring solvent-based adhesive strippers.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 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. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. 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 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

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. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Form ties.
4. Waterstops.
5. Form-release agent.

- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).
 - a. Location of construction joints is subject to approval of the Architect.
3. Indicate location of waterstops.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Minutes of preinstallation conference.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with 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, so that resulting concrete conforms to the required shapes, lines, and dimensions.
1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
1. Provide continuous, true, and smooth concrete surfaces.
 2. Furnish in largest practicable sizes to minimize number of joints.
 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).
 - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Profile: Flat dumbbell with center bulb.
 2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.8 mm thick; nontapered).
- B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
1. Profile: Flat dumbbell with center bulb.
 2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.8 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).

2.4 RELATED MATERIALS

- A. 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.
- B. 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.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. 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.
 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. 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.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301 (ACI 301M).
- 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) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch (25 mm).
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips.
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).

- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- 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.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. 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.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 4. Secure waterstops in correct position at 12 inches (305 mm) on center.
 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.
 6. Clean waterstops immediately prior to placement of concrete.
 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

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 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor shall engage a special inspector 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. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 - 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

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

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement to Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

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

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Plain Steel Wire: ASTM A 82, galvanized.
- C. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar 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 in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - b. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - c. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. 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.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.
 - 2. Stagger splices in accordance with ACI 318 (ACI 318M).
 - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches (305 mm).

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

- A. 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.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor will engage a special inspector 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.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

1.2 DEFINITIONS

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

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.
6. Admixtures:

- a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at

time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

7. Vapor retarders.
8. Liquid floor treatments.
9. Curing materials.
10. Joint fillers.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

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

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.

4. Vapor retarders.
5. Joint-filler strips.

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

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.
6. Admixtures:

C. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

D. Preconstruction Test Reports: For each mix design.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Ready-Mixed 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.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 PRECONSTRUCTION TESTING

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

1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M).

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Cementitious Materials:

- 1. Portland Cement: ASTM C150/C150M, Type I, gray.
- 2. Fly Ash: ASTM C618, Class C or F.
- 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- 4. Blended Hydraulic Cement: ASTM C595/C595M, [Type IS, portland blast-furnace slag] [Type IP, portland-pozzolan] [Type IL, portland-limestone] [Type IT, ternary blended] cement.

- B. Normal-Weight Aggregates: ASTM C33/C33M, [Class 3S] [Class 3M] [Class 1N] <Insert class> coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

- a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
- b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
- c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).

2. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.

3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

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

- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures 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.
- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable .

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 LIQUID FLOOR TREATMENTS

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

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 burlap-polyethylene sheet.
1. Color:
 - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
 - b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
 - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- C. Curing Paper: Eight-foot- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- D. Water: Potable or complying with ASTM C1602/C1602M.
- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

- F. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Floor Slab Protective Covering: Eight-feet- (2438-mm-) wide cellulose fabric.

2.7 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, in accordance with ACI 301 (ACI 301M).
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing 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.

2.8 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
 - 1. Exposure Class: ACI 318 (ACI 318M) F2, S0, W0, C1.
 - 2. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
 - 3. Maximum w/cm: 0.45.
 - 4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm)

5. Air Content:
 - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.
6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

B. Class B: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 (ACI 318M) F0, S0, W0, C0.
2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Maximum w/cm: 0.50.
4. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m)
5. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with 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 five 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 INSTALLATION OF EMBEDDED ITEMS

- 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.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. 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.

3.2 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
 4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

3.3 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls [as indicated on Drawings] <Insert spacing>. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control 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 control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control 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 cracks.
- D. Isolation Joints in Slabs-on-Ground: 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 on Drawings.
 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:
1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. 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.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. 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.
- F. 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. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

- a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1 inch (25 mm).
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
 - e. Apply to concrete surfaces [ot exposed to public view.
2. ACI 301 (ACI 301M) Surface Finish SF-3.0:
- a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1/8 inch (3 mm).
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

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

3.6 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch (6 mm) in one direction.
 3. Apply scratch finish to surfaces to receive concrete floor toppings.
- C. Float Finish:
1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.
 3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to 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.
 7. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm)
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces 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 perpendicular to main traffic route.
1. Coordinate required final finish with Architect before application.
 2. 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 locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.

3. 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 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4500 psi (31 MPa) 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.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1,) before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

- a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
- b. Continuous Sprinkling: Maintain concrete surface continuously wet.
- c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
- d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
- e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches (300-mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 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.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.

- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches (150 mm) and sealed in place.
- 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
- 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) 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.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.9 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

3.10 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with 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 three days' old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. 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 in accordance with manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: Contractor to engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

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

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

- 1) Project name.
- 2) Name of testing agency.
- 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
- 4) Name of concrete manufacturer.
- 5) Date and time of inspection, sampling, and field testing.
- 6) Date and time of concrete placement.
- 7) Location in Work of concrete represented by samples.
- 8) Date and time sample was obtained.
- 9) Truck and batch ticket numbers.
- 10) Design compressive strength at 28 days.
- 11) Concrete mixture designation, proportions, and materials.
- 12) Field test results.
- 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
- 14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size,

design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with 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.
 - 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.
2. Slump: ASTM C143/C143M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow: ASTM C1611/C1611M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. 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:
 - a. 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.
 - a. 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 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. 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) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
 11. 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.
 12. Additional Tests:
 - a. 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.
 - b. 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.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 (ACI 301M), section 1.6.6.3.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.12 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. 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.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 040120.63 - 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 CMU masonry.

1.3 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 estimated quantities supplied by the Contractor and Approved by the Owner.
 - 2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.4 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform CMU 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. Remove windows and doors indicated on Drawings.
 - 6. Cut openings in masonry for new windows as shown in Drawings.
 - 7. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
 - 8. Repair masonry, including replacing existing masonry with new masonry materials.
 - 9. Rake out mortar from joints to be repointed.
 - 10. Install new windows and doors in appropriate openings.
 - 11. Point mortar and sealant joints.
 - 12. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.

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 CMUs 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 Verification: For the following:
 - 1. Each type of CMU 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 CMU type, provide straps or panels containing at least four CMUs. Include multiple straps for CMU with a wide range.
 - 2. Accessories: Each type of accessory and miscellaneous support.

1.6 INFORMATIONAL SUBMITTALS

- A. Quality-control program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver CMU 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 CMUs to prevent overstressing, chipping, defacement, and other damage.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit CMU masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Temperature Limits: Repair CMU masonry only when air temperature is between 40 and 90 deg F 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, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
 - 2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F 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 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 CMU (CMU, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site
- B. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
- C. Weight Classification: Normal weight.
- D. Provide Type I, moisture-controlled units.

- E. Size (Width): Manufactured to the following dimensions:
 - 1. 4 inches nominal; 3-5/8 inches actual.
 - 2. 6 inches nominal; 5-5/8 inches actual.
 - 3. 8 inches nominal; 7-5/8 inches actual.
 - 4. 10 inches nominal; 9-5/8 inches actual.
 - 5. 12 inches nominal; 11-5/8 inches actual.
- F. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, 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 C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
 - 1. For pigmented mortar, use a colored cement formulation as required to produce the color indicated or, if not indicated, as selected from manufacturer's standard formulations.
 - a. Pigments shall not exceed 10 percent of portland cement by weight for mineral oxides nor 2 percent for carbon black.
 - b. Pigments shall not exceed 5 percent of masonry cement by weight for mineral oxides nor 1 percent for carbon black.
 - 2. For colored-aggregate mortar, use natural color or white cement as necessary to produce required mortar color.
- D. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch6.5 mm thick, use aggregate graded with 100 percent passing the No. 161.18-mm sieve.
 - 1. Colored-Mortar Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C 404.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer. Use at

locations where concrete masonry units are manufactured with integral water repellent. Provide dry-block by W.R. Grace or approved equal.

- I. Water: Potable.
- J. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Colored Portland Cement-Lime Mix:
 - a. Lehigh Custom Color Portland/Lime; Lehigh Portland Cement Co.
 - b. Riverton Portland Cement Lime Custom Color; Riverton Corporation (The).
 - c. Color: To be selected.
 - 2. Cold-Weather Admixture:
 - a. Accelguard 80; Euclid Chemical Co.
 - b. Morseled; W. R. Grace & Co., Construction Products Division.
 - c. Trimix-NCA; Sonneborn, Div. of ChemRex, Inc.

2.4 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of CMUs, 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. 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.

2.5 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. 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. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.
- C. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- D. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
1. Limit cementitious materials in mortar to portland cement and lime.
 2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
 3. For masonry below grade, in contact with earth, and where indicated, use Type M.
 4. For load bearing CMU walls, reinforced masonry and where indicated, use Type S.
 5. For exterior, above-grade, non-load-bearing walls and parapet walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 7 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches 200 to 280 mm as measured according to ASTM C 143.

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 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.

3.3 PARGING

- A. Parge predampened masonry walls at repairs and new window openings to match existing finish, where indicated, with Type S or Type N mortar applied in two (2) uniform coats to a total thickness to match existing. Scarify first parge 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 the parging until cured.

3.4 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 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.

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 QUALITY ASSURANCE

- A. Sample Panels: 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 each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 36 inches (900 mm) high by full thickness.

1.6 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.

- 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).
 - 2. Density Classification: Normal weight.

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. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed billet bars, galvanized finish.
- 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) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 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), with prefabricated corner and tee units.

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 0.187-inch- (4.76-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.

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.
 2. For reinforced masonry, use Type S.
 3. For mortar parge coats, use 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 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.
 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 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.

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)] [1 inch (25 mm)] [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.

3.8 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

- 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 seven days and 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 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors.
3. Shrinkage-resistant 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 ANSI/AISC 303.

1.3 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Shop primer.
8. Galvanized-steel primer.
9. Etching cleaner.
10. Galvanized repair paint.
11. Shrinkage-resistant grout.

- ##### B. Shop Drawings: Show fabrication of structural-steel components.

- ##### C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Mill test reports for structural-steel materials, including chemical and physical properties.
- C. Source quality-control reports.
- D. Field quality-control 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 BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
 - 2. Option 2: Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
 - b. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Moment frame or Shear wall system.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M, Grade 50 (Grade 345).
- B. Channels, Angles: ASTM A36/A36M, Grade 50 (Grade 345).
- C. Plate and Bar: ASTM A36/A36M, Grade 50 (345).
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B 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 AND CONNECTORS

- A. High-Strength A325 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. Zinc-Coated High-Strength A325 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: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex 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: Mechanically deposited zinc coating.
- D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.
 - 1. Configuration: Straight.
 - 2. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A36/A36M.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," or Section 099600 "High-Performance Coatings."
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer:

1. 1-coat of rust-inhibitive primer, min. 1.5 mil thick
2. Etching Cleaner: MPI#25, for galvanized steel.
3. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.6 SHRINKAGE-RESISTANT 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.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.10 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 unless indicated to be painted.
 6. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 2.
 2. SSPC-SP 3.
 3. SSPC-SP 7 (WAB)/NACE WAB-4.
 4. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16
- D. Priming: Immediately after surface preparation, apply primer in accordance with 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.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage]a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - 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/E94M.
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M.
 5. Prepare test and inspection reports.
- B. AFFIDAVIT FROM ERECTOR: The General Contractor shall be required to provide an affidavit, at the completion of the job, to the effect that the structural steel frame is plumb and level within the normal tolerances specified in the code.

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 in accordance with ANSI/AISC 303 and ANSI/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. Snug-tighten 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 shrinkage-resistant 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 grouting.

- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a 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: Engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 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/E94M.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Roof deck.
2. MANUFACTURER'S CERTIFICATE of compliance with Steel Deck Institute Specifications
3. Submit structural analysis data to indicate design complies with design loading sealed and signed by the Pennsylvania registered structural engineer responsible for its preparation.

B. 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. Research 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. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade **AG60 (Z180)** zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: **Manufacturer's standard.**
 2. Deck Profile: **Type WR, wide rib.**
 3. Profile Depth: **As indicated**
 4. Design Uncoated-Steel Thickness: **As indicated.**

2.3 ACCESSORIES

- A. 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: **ASTM A780/A780M.**
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION

- 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** flanges to top of deck. Space **welds** not more than **12 inches (305 mm)** apart with at least one **weld** at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and **weld**.
- 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** 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 REPAIR

- 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** of prime-painted deck immediately after installation, and apply repair paint.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

END OF SECTION 053100

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. Framing with dimension lumber.
 - 2. Rooftop equipment bases and support curbs.
 - 3. Wood blocking and nailers.
 - 4. Wood furring.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2].
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium
- 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. Application: Treat 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, and similar concealed members in contact with masonry or concrete.

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 beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
 2. 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.
 3. 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.
 4. 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.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- D. Application: Treat items indicated on Drawings

2.4 DIMENSION LUMBER FRAMING

- A. Other Framing: Construction or No. 2 grade of the following species:
1. Hem-fir (north); NLGA.
 2. Douglas fir-larch; WCLIB or WWPA.
 3. Southern pine or mixed southern pine; SPIB.
 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.

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 grade lumber of any of the following species:
1. Hem-fir (north); NLGA.
 2. Mixed southern pine or southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. Concealed Boards: 15percent maximum moisture content of any of the following species and grades:
1. Mixed southern pine or southern pine, No. 3 grade; SPIB.
 2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 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 or Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

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, 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 panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. 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.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal size furring as shown on Drawings.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- as shown on Drawings.

3.4 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 062023 - INTERIOR FINISH CARPENTRY

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. Related Requirements:
 - 1. Division 6 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view and for framing exposed to view.
 - 2. Division 9 Section "Interior Painting" for priming and backpriming of interior finish carpentry.

1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
- B. Samples: For each exposed product and for each color and texture specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
 - 1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 - 2. Provide for air circulation around stacks and under coverings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Softwood Plywood: DOC PS 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. 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.

3.4 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements.

1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces.

B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.6 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 070150.19 - PREPARATION FOR REROOFING

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. Full tear-off of roof system at areas indicated on Drawings.
- 2. Removal of flashings and counterflashings.
- 3. Temporary roofing.

B. Related Requirements:

- 1. Section 011000 "Summary" for use of premises and for phasing requirements.
- 2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.

1.3 DEFINITIONS

- A. EPS: Molded (expanded) polystyrene.

- B. Full Roof Tear-off: Removal of existing roofing system down to existing roof deck.

- C. OSB: Oriented strand board.

- D. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.

- 1. Meet with Owner, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing tear-off, including, but not limited to, the following:
 - a. Reroofing preparation, including roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system components that are to remain.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
 - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
 - e. Existing roof deck conditions requiring Architect notification.
 - f. Existing roof deck removal procedures and Owner notifications.
 - g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
 - h. Structural loading limitations of roof deck during reroofing.
 - i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
 - j. HVAC shutdown and sealing of air intakes.
 - k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
 - l. Asbestos removal and discovery of asbestos-containing materials.
 - m. Governing regulations and requirements for insurance and certificates if applicable.
 - n. Existing conditions that may require Architect notification before proceeding.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
 1. Include certificate that Installer is approved by warrantor of existing roofing system.
 2. Include certificate that Installer is licensed to perform asbestos abatement.
- B. Field Test Reports:
 1. Fastener pull-out test report.
- C. 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.

- D. Landfill Records: Indicate receipt and acceptance of demolished roofing materials and hazardous wastes, such as asbestos-containing materials, by a landfill facility licensed to accept them.

1.7 CLOSEOUT SUBMITTALS

- A. Certified statement from manufacturer for existing warranted roof system stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.
- B. Regulatory Requirements:
 - 1. Comply with governing EPA notification regulations before beginning roofing removal.
 - 2. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.9 FIELD CONDITIONS

- A. Existing Roofing System: Built-up asphalt roofing.
- B. Owner 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.
- 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.
- F. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed to 1,500 LBS for rooftop equipment wheel loads and 40 PSF 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.
- H. Hazardous Materials: 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 may be present.
1. Do not disturb hazardous materials or items suspected of containing hazardous materials.
 2. Coordinate reroofing preparation with hazardous material remediation, if required to prevent water from entering existing roofing system or building.

1.10 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.
1. Notify warrantor before proceeding with the Work.
 2. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect.
 - a. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

- A. EPS Insulation: ASTM C578.
- B. Plywood: DOC PS 1, Grade CD, Exposure 1.
- C. OSB: DOC PS 2, Exposure 1.

2.2 TEMPORARY ROOFING MATERIALS

- A. Design and selection of materials for temporary roofing are Contractor's responsibilities.
- B. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- C. Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet.
- D. Glass-Fiber Felts: ASTM D2178/D2178M, Type IV, asphalt-impregnated, glass-fiber felt.

- E. Asphalt Primer: ASTM D41/D41M.
- F. Roofing Asphalt: ASTM D312/D312M, Type III or IV.
- G. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Approvals' RoofNav.

2.3 INFILL AND REPLACEMENT MATERIALS

- A. Use infill materials matching existing roofing system materials unless otherwise indicated.
 - 1. Infill materials are specified in Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" unless otherwise indicated.
- B. Steel deck is specified in Section 053100 "Steel Decking."
- C. Wood blocking, curbs, and nailers are specified in Section 061053 Miscellaneous Rough Carpentry."
- D. Plywood roof sheathing is specified in Section 061600 "Sheathing."

2.4 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Protect existing roofing system that is not to be reroofed.
 - 2. Loosely lay 1-inch- (25-mm-) minimum thick, EPS insulation over existing roofing in areas not to be reroofed.
 - a. Loosely lay 15/32-inch (12-mm) plywood or OSB panels over EPS. Extend EPS past edges of plywood or OSB panels a minimum of 1 inch (25 mm).
 - 3. Limit traffic and material storage to areas of existing roofing that have been protected.
 - 4. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
 - 5. Comply with requirements of existing roof system manufacturer's warranty requirements.
- B. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

- C. Shut off rooftop utilities and service piping before beginning the Work.
- D. Test existing roof drains to verify that they are not blocked or restricted.
 - 1. Immediately notify Architect of any blockages or restrictions.
- E. 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.
- F. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- G. 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.
- 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 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.
- D. Full Roof Tear-off: Where indicated on Drawings, remove existing roofing and other roofing system components down to the existing roof deck.
 - 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.

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."

3.4 INFILL MATERIALS INSTALLATION

- A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.

1. Installation of infill materials is specified in Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing.
2. Installation of wood blocking, curbs, and nailers is specified in Section 061053 Miscellaneous Rough Carpentry."

B. Install new roofing patch over roof infill area.

1. If new roofing is installed the same day tear-off is made, roofing patch is not required.

3.5 TEMPORARY ROOFING

A. Install approved temporary roofing over area to be reroofed.

B. Install temporary roofing over area to be reroofed.

1. Install two glass-fiber felts, lapping each sheet 19 inches (483 mm) over preceding sheet.
2. Embed glass-fiber felt in a solid mopping of hot roofing asphalt applied within equiviscous temperature range.
3. Glaze-coat completed surface with hot roofing asphalt.

C. Remove temporary roofing before installing new roofing.

3.6 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 counterflashings that are to remain.

1. Replace metal counterflashings damaged during removal with counterflashings specified in Section 076200 "Sheet Metal Flashing and Trim."

C. Inspect parapet, wood blocking, curbs, and nailers for deterioration and damage.

1. If parapet, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

D. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to comply with Section 061053 Miscellaneous Rough Carpentry."

3.7 FASTENER PULL-OUT TESTING

A. Perform fastener pull-out tests according to SPRI FX-1, and submit test report to Architect and roofing manufacturer before installing new roofing system.

1. Obtain roofing manufacturer's approval to proceed with specified fastening pattern.

- a. Roofing manufacturer may furnish revised fastening pattern commensurate with pull-out test results.

3.8 DISPOSAL

- A. Collect demolished materials and place in containers.
 1. Promptly dispose of demolished materials.
 2. Do not allow demolished materials to accumulate on-site.
 3. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150.19

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cold-applied, asphalt emulsion dampproofing for below grade installation.
 - 2. Exterior face of concrete and masonry indicated to receive brick veneer/ cladding.
- B. Related Requirements
 - 1. Division 4 "Unit Masonry Assemblies".

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified, including data substantiating that materials comply with requirements for each dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course.
 - 1. Certification by dampproofing manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed bituminous dampproofing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

- A. Substrate: Proceed with dampproofing only after substrate construction and penetrating work have been completed.

- B. Weather Limitations: Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.
- C. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cold-Applied, Asphalt Emulsion Dampproofing:
 - a. ChemRex, Inc.; Sonneborn Building Products Div.
 - b. Euclid Chemical Co.
 - c. Karnak Chemical Corporation.
 - d. Koppers Industries, Inc.
 - e. Meadows: W.R. Meadows, Inc.

2.2 BITUMINOUS DAMPPROOFING

- A. General: Provide products recommended by manufacturer for designated application.
 - 1. Spray Grade: Asphalt roof coating, consisting of an asphalt base with petroleum solvents and no mineral fibers, complying with ASTM D 4479, Type I.
- B. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions.
 - 1. Spray Grade: Emulsified asphalt, prepared with mineral-colloid emulsifying agents without fibrous reinforcement, complying with ASTM D 1227, Type III.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Asphalt primer complying with ASTM D 41, for asphalt-based dampproofing.
- B. Glass Fabric: Woven glass fabric, treated with asphalt, complying with ASTM D 1668, Type I.
- C. Protection Course, Roll Roofing Type: Smooth-surfaced roll roofing, complying with ASTM D 224, Type II.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.
- B. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.
- C. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.
- D. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.
- E. Prime substrate as recommended by prime materials manufacturer.
- F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.
- B. Application: Apply dampproofing to the following surfaces.
 - 1. Exterior, below-grade surfaces of exterior concrete or masonry walls in contact with earth or other backfill and where space is enclosed on opposite side.
 - 2. Back side of concrete or masonry retaining walls and stone facing to prevent percolating of water through the wall or facing.
 - 3. In multiwythe exterior masonry walls, apply dampproofing to cavity face of back up wythes of masonry.
- C. Cold-Applied Asphalt Dampproofing: For exterior surfaces, provide either emulsified or cut-back, asphalt dampproofing materials, at Contractor's option. For interior surfaces, provide only emulsified asphalt materials.
- D. Reinforcement: At changes in plane or where otherwise shown as "reinforced," install lapped course of glass fabric in first coat of dampproofing compound before it thickens.
- E. Bituminous Cant Strips: Install 2-by-2-inch (50-by-50-mm) cant strip of bituminous grout at base of vertical dampproofing where it meets horizontal surface.
- F. Apply vertical dampproofing down walls 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. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when the Project is completed.

3.3 COLD-APPLIED, ASPHALT EMULSION DAMPPROOFING

- A. Spray Grade: Brush or spray apply a coat of asphalt emulsion dampproofing at a rate of 1.5 to 2.5 gal./100 sq. ft. (0.6 to 1 L/sq. m), depending on substrate texture, to produce a uniform, dry-film thickness of not less than 15 mils (0.4 mm). Apply in 2 coats, if necessary, to obtain required thickness, allowing time for complete drying between coats.

3.4 PROTECTION AND CLEANING

- A. Protect exterior, below-grade dampproofing membrane from damage until backfill is completed. Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

3.5 INSTALLATION OF PROTECTION COURSE

- A. General: Install protection course of type indicated over completed-and-cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attaching of protection materials. Support with spot application of trowel-grade mastic where not otherwise indicated.

END OF SECTION 071113

SECTION 072100 – BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concealed building insulation.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 4 Section "Unit Masonry" for insulation installed in cavity walls and masonry cells.
 - 2. Division 7 Section "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of insulation product specified.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:
 - 1. Glass-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Owens-Corning Fiberglas Corporation.
 - c. John Mansville.
 - 2. Polyisocyanurate insulation for miscellaneous use.
 - a. Atlas Roofing Corporation.
 - b. Dow Chemical Company.
 - c. Rmax, Inc.

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Formaldehyde-Free Batt/Blanket Insulation: Flexible, unfaced blankets made of inorganic glass fibers bonded with formaldehyde-free thermosetting resin, complying with ASTM C 665 and with glass fiber portion classified as noncombustible when tested in accordance with ASTM C 136.

1. Acceptable Product: Johns Manville Thermal-SHIELD™ Free.
 2. Thermal Resistance (R-value): 19 hr sq ft degF/Btu (3.3 sq m K/W).
 3. Thickness: 6-1/4 inches (159 mm).
 4. Size: 16 by 96 inches (406 by 2438 mm).
 5. Size: 24 by 48 inches (610 by 1219 mm).
 6. Size: 24 by 96 inches (610 by 2438 mm).
 7. Surface Burning Characteristics: Flame spread index of 25 or less; smoke developed index of 50 or less; when tested in accordance with ASTM E 84 with specified facing.
 8. Recycled Content: Certified by Scientific Certification Systems to contain minimum of 18 percent post-consumer and 7 percent pre-consumer recycled glass product, on average of manufacturer's products.
 9. Air Erosion Resistance: Satisfactory up to 1,000 ft/min (5.08 m/s) when tested in accordance with UL 181.
 10. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- C. Faced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type III, Class A (blankets with reflective vapor-retarder membrane facing and flame spread of 25 or less); with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on 1 face.
1. Mineral-Fiber Type: Fibers manufactured from glass, slag wool, or rock wool.
 2. Flanged Units: Provide blankets fabricated with facing incorporating 5-inch- wide flanges along edges for attachment to framing members.
- D. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2 with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches (101 mm).
1. Manufacturers:
 - a. Atlas Roofing Corporation.
 - b. Dow Chemical Company.
 - c. Rmax, Inc.

2.3 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Low VOC product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
- B. Protection Board: Premolded, semirigid asphalt/fiber composition board, 1/4 inch thick, formed under heat and pressure, standard sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
- B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to written instructions of insulation manufacturer.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in

completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

- C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Set reflective, foil-faced units with not less than 0.75-inch air space in front of foil as indicated.
- E. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 - 1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- F. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces. Compact to approximately 40 percent of normal maximum volume.

3.6 PROTECTION

- A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

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. Vapor-retarding, fluid-applied air barriers.

B. Related Requirements:

- 1. Division 6 Section "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

- 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
- 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside

and outside corners, terminations, and tie-ins with adjoining construction.

3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage Engage a qualified testing agency to perform preconstruction testing on field mockups.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single

source from single manufacturer.

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. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, 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 E 2357.

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:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Carlisle Coatings & Waterproofing Inc.; Barriseal R
 - 2) Henry Company, Sealants Division: Air-Bloc 06 QS
 - 3) Hohmann & Barnard, Inc.; ExoAir 120.
 - 4) W.R. Meadows, inc. Air-Shield LM (All season).
 - 2. Synthetic Polymer Type:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Carlisle Coatings & Waterproofing Inc; Fire Resist Barritech NP
 - 2) Grace Construction Products; W.R. Grace & Co. -Conn.; Perm-A-Barrier Liquid.
 - 3) Henry Company; Air-Bloc 32MR
 - 4) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight.
 - 5) W.R. Meadows, inc.; Air-Shield LSR.
 - 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 E 2178.
 - b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m) ASTM E 96/E 96M, Desiccant Method.
 - c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

- d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) tested according to ASTM D 4541.
- e. UV Resistance: Can be exposed to sunlight for 30 days according to manufacturer's written instructions.

2.4 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.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch (0.64 mm) thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low- modulus) silicone sealant for bonding extrusions to substrates.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. GE construction Sealants; Momentive Performance materials Inc.; US11000 UltraSpan.
 - c. Pecora corporation; Sil-Span.
 - d. Tremco Incorporated; Spectrem Simple Seal.

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 substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.

3. Verify that substrates are visibly dry and free of moisture.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. 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.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation 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.

3.3 ACCESSORIES INSTALLATION

- A. Install accessory 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. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
 - D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
 - E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extrusion 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.
 1. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
 - F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
 - G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
 - H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.
 - I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
 - J. 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.
- 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION
- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. 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) applied in one or more equal coats.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

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. 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. Vapor retarder.
5. Roof insulation.
6. Cover board.
7. Walkways.

- B. Section includes the installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking, and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for premanufactured metal copings roof edge fasciae gravel stops roof edge flashings counterflashings.
6. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
7. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 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. 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. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
5. Crickets, saddles, and tapered edge strips, including slopes.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Cap Sheet: Samples of manufacturer's standard colors for selection by Architect.
2. Flashing Sheet: Samples of manufacturer's standard colors for selection by Architect.
3. Aggregate surfacing material in gradation and color required.

4. Walkway Pads or Rolls: Samples of manufacturer's standard colors for selection by Architect.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. 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.

C. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of membrane roofing system, from ICC-ES.

E. Field Test Reports:

1. Concrete internal relative humidity test reports.

2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is **UL listed** 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.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
 - 1. Protect stored liquid material from direct sunlight.
 - 2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
 - 1. Store in a dry location.
 - 2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 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. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, roof pavers, and other components of roofing system.
 - 2. Warranty Period: **25** years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards,

vapor retarder, substrate board, roof pavers and walkway products, for the following warranty period:

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. 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.
- B. 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.
- 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): 90 **lbs/sq. ft.**
 2. Zone 2 (Roof Area Perimeter): 120 **lbs/sq. ft.**
 3. Zone 3 (Roof Area Corners): 120 **lbs/sq. ft.**
- 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-90.**
 2. Hail-Resistance Rating: **SH.**
- E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, [**Class A**] [**Class B**] [**Class C**]; for application and roof slopes indicated; testing by a qualified testing agency.
1. Identify products with appropriate markings of applicable testing agency.
- F. 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. Basis of Design is Tremco Burmastic 200 Composite Ply Premium 4 ply SBS Modified Bitumen Cold Applied Roofing System.

2.3 BASE SHEET MATERIALS

- A. Basis of Design is Tremco Burmastic Composite Ply Premium. SBS-Modified Bitumen Polyester and Fiberglass Mat Base Sheet: ASTM 4601-04, Type II, 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. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Firestone Building Products
 - 2. Johns Manville
 - 3. GAF Commercial Roofing Products
 - 4. Carlisle
 - 5. Certainteed Corp.

2.4 INTERPLY SHEETS

- A. Basis of Design is Tremco Burmastic Composite Ply Premium.

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 a combination of polyester and fiberglass fabric, suitable for cold adhesive or hot asphalt application method.
 - 1. Tremco
 - 2. Firestone Building Products
 - 3. Johns Manville
 - 4. GAF Commercial Roofing Products
 - 5. Carlisle
 - 6. Certainteed Corp.
- B. Smooth-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric smooth surfaced, suitable for application method specified, and as follows:
 - 1. Color: White.
- C. 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.

2.6 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. Roof Vents: As recommended by roof membrane manufacturer.
 - 1. Size: Not less than 4-inch (100-mm) diameter.
- D. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- E. 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.
- F. 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.
- G. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.
- 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; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.
- J. 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.

2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards, manufactured by roof membrane manufacturer.
- 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. Johns Manville
 - 2. GAF Commercial Roofing Products
 - 3. Carlisle
 - 4. Certainteed Corp.
 - a. Facer Type VII glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.

2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. 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.
- C. 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.
- D. Wood Nailer Strips: Comply with requirements in Section 061053 "Miscellaneous Rough Carpentry."
- E. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch (11 mm) thick.

2.9 ASPHALT MATERIALS

- A. Asphalt Primer: ASTM D41/D41M.
- B. Roofing Asphalt: ASTM D312/D312M, Type III or IV as recommended by roofing system manufacturer for application.
- C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

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 roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.
 - 1. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
 - 1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, 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. 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 INSTALLATION OF INSULATION

- 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. 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 deg F (14 deg C)**.
- D. Installation Over Metal Decking:
 - 1. Install base layer of insulation with 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. 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 using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation, with joints of each layer offset not less than **12 inches (300 mm)** from previous layer of insulation.
- a. Install with long joints continuous and with end joints staggered not less than **12 inches (300 mm)** in adjacent rows.
 - 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)**.
 - e. 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 ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 2) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF ROOFING MEMBRANE, 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. 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.

3.6 INSTALLATION OF BASE SHEET

- 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 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. Install base sheet without wrinkles, rears, and free from 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 (450 mm)**.
 - d. **Completely bond and seal laps**, leaving no voids.
 - e. Roll laps with a **20-pound (9-kg)** roller.
 - 7. Repair tears and voids in laps and lapped seams not completely sealed.
 - 8. 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.

3.7 INSTALLATION OF INTERPLY SHEETS

- A. Install **two** 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.

3.8 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

- 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 cold-applied adhesive.
 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. **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.

3.9 INSTALLATION OF FLASHING AND STRIPPING

- 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 **cold-applied adhesive**.
 - c. Seal all laps.

3. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
- 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) 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.

3.10 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 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 0762000 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Manufactured Products:
 - a. Manufactured reglets and counterflashing.
- 2. Formed Products:
 - a. Formed wall sheet metal fabrications.
 - b. Formed equipment support flashing.

B. Related Sections:

- 1. Division 4 Section "Unit Masonry Assemblies" for flashing, installed with masonry.
- 2. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
- 3. Division 7 Section " Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing " for installing sheet metal flashing and trim integral with membrane roofing.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated 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. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
 - 1. Retain wind zone from four subparagraphs below to suit Project. Wind zones are areas of a roof as they relate to roof slope and design wind speed. See FMG Loss Prevention Data Sheet 1-28, Table 4. Wind Zone 1 is subdivided into two ranges. FMG Loss Prevention Data Sheet 1-49 tabulates a range of metal types and thicknesses that meet Wind Zones 1 and 2 and prescribes minimum anchoring of wood nailers, continuous cleats (hook strips), roof edge flashing, copings, and counterflashing. Wind Zone 3 requires assemblies of special design.

2. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30-lbf/sq. ft. (1.44-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C) ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

D. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

3. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

F. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

G. Warranty: Sample of special warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2. Exposed Coil-Coated Finishes:

a. Two-Coat Fluoropolymer: AAMA 620. 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.

3. Color: Provide custom color.

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.

C. Zinc Sheet: Zinc, 99 percent pure, alloyed with a maximum of 1 percent copper and titanium; with manufacturer's standard factory-applied, flexible, protective back coating.

1. Finish: Bright rolled.

2.2 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and 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.
 - 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 Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
 - 1. For Zinc-Tin Alloy-Coated Copper: ASTM B 32, 100 percent tin.
 - 2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. 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 thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

- I. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products Inc.
 - d. Hickman, W. P. Company.
 - e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 - f. Keystone Flashing Company, Inc.
 - g. National Sheet Metal Systems, Inc.
 - h. Sandell Manufacturing Company, Inc.
 2. Material: Aluminum, 0.024 inch thick.
 3. 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.
 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 5. 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 lower edge.
 6. Finish: Mill.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 1. 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.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- K. Do not use graphite pencils to mark metal surfaces.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Base Flashing: Fabricate from the following materials:
 - 1. Aluminum: 0.040 inch thick.
- B. Counterflashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
- C. Flashing Receivers: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
- D. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- E. Roof-Drain Flashing: Fabricate from the following materials:

1. Copper: 12 oz./sq. ft. thick.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
- C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- D. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, 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. 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 Division 7 Section "Joint Sealants."

- F. 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, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.
 2. Pre-tinning is not required for zinc-tin alloy-coated stainless steel and zinc-tin alloy-coated copper.
 3. 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.
 4. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 5. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant, interlocking folded seam or blind rivets and sealant.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 MISCELLANEOUS FLASHING INSTALLATION

- A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

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.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. 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.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

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. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.

B. Related Requirements:

1. Division 6 Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 7 Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
3. Division 7 Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
4. Division 7 Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

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.

B. 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.
2. Include details for expansion and contraction; including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

- C. Samples: For each type of roof specialty and for each color and texture specified.
- D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.
- E. Samples for Verification:
 - 1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
 - 2. Include copings roof-edge specialties and roof-edge drainage systems made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. 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 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. 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. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.050 inch (1.27 mm) thick.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.

2.3 ROOF-EDGE SPECIALTIES

- A. 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. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.050 inch (1.27 mm) thick.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 2. Corners: Factory mitered and soldered.
 3. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
 4. Receiver: Manufacturer's standard material and thickness.

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. .
 2. Aluminum Sheet: 0.050 inch (1.27 mm) thick.
 3. Gutter Profile: Ogee according to SMACNA's "Architectural Sheet Metal Manual."
 4. Corners: Factory mitered and soldered.
 5. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
 6. Gutter Accessories: Wire ball downspout strainer.
- B. Downspouts: Plain round complete with smooth-curve elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.050 inch (1.27 mm) thick.
- C. Aluminum Finish: Mill Two-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

2.5 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.
- B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.6 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.

2.7 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 Aluminum: Aluminum or Series 300 stainless steel.
- B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane 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.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted 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 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.
- D. 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. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard 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 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

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 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, and roof-edge specialties.
 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).

3.3 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 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 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.

3.4 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

3.5 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.

3.6 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 24 inches (610 mm) 30 inches (762 mm) apart. Attach ends with rivets and 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.
- 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. Connect downspouts to underground drainage system indicated.

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. On completion of installation, clean finished surfaces, including removing unused fasteners, metal

filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 079200 - JOINT SEALANTS

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. Nonstaining silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Latex joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- 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. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Field-Adhesion-Test Reports: For each sealant application tested.

F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

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.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. 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.
 - 1. Provide product by Pecora Corp., Sika Corp., or Tremco Corp. or approved equal.

2.3 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.
 - 1. Provide product by Pecora Corp., Sika Corp., or Tremco Corp. or approved equal.

- B. 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.

- 1. Provide product by Lymtal International or approved equal.

2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 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, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. 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 of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- C. 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.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, M, P, 50, T, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. 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. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - g. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. 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 walls and partitions.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. 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
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

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 hollow-metal work.
- B. Related Requirements:
 - 1. Division 8 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. 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.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

D. Schedule: Provide a schedule of hollow-metal work 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amweld International, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Curries Company; an Assa Abloy Group company.
 4. Greensteel Industries, Ltd.

5. Pioneer Industries, Inc.
6. Republic Doors and Frames.
7. Steelcraft; and Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work 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 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 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 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.
1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.053 inch.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Polyisocyanurate.
 3. Frames:
 - a. Materials: Metallic-coated, steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Full profile welded.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Zinc-Iron Alloy-Coated galvanized steel, ASTM A 653, Class A60, 14 gage, 0.067" Zinc-Iron Alloy-Coated galvanized steel, with closed tops.
 - 1) Include galvanized components and internal reinforcements with galvanized doors.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Polyisocyanurate.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. 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.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, 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 E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 08800 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 2. Fire Door Cores: As required to provide fire-protection ratings indicated.
 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 7. 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 beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Sidelight 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 butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
 7. 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.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; 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 applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 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.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish for Interior Doors and Frames: 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.
- B. Exterior doors, frames and frame components are required to be cleaned, phosphatized, and finished with one coat of baked-on rust inhibiting prime paint in accordance with the ANSI/SDI A250.10 "Test Procedures and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.9 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

- B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

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 the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 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. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.

- e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout 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: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. 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.
 6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08800 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. 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 hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. 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.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081100

SECTION 083113 - ACCESS 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 access doors and frames for walls and ceilings.

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.
- B. Product Schedule: For access doors and frames.

PART 2 - PRODUCTS

2.1 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: Wall and ceiling.
 - 3. Door Size: as indicated on drawings or as required to service equipment. Coordinate with Mechanical/plumbing contractor.
 - 4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
 - 5. Frame Material: Same material, thickness, and finish as door.
 - 6. Latch and Lock: Cam latch, key operated.

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. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
- E. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- F. Frame Anchors: Same material as door face.
- G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 COORDINATION

- A. Coordinate access doors and frames with general, mechanical and plumbing contractors for exact size, operation and location.
- B. Coordinate keying with Owner.

2.4 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 mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
 - 1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. 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.

F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.5 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. 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.

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 access doors and frames.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083301 SECURITY ROLL UP DOORS

PART 1 – GENERAL

1.01 SUMMARY

1. Section includes:
 - a. Security Roll-Up Doors`

1.02 COORDINATION

1. Coordinate installation of anchorages for Security Roll Up Doors, frames and openings. Furnish setting drawings, templates and directions for installation.

1.03 SUBMITTALS

2. Product Data:
 - a. Submit manufacturer's product data for all specified components, including specifications, finish information and installation instructions.
3. Shop Drawings:
 - a. Submit scaled shop drawings showing layout, sizes and types, product materials, components and accessories, fabrication data, wiring diagrams for motor driven operators, finishes, rough-in dimensions, anchorage with installation requirements and location details.
4. Samples:
 - a. Manufacturer's standard array of colors for selection by Architect.
5. Quality Assurance Submittals:
 - a. Test Reports: Engineer raised seal test reports showing compliance with specified requirements.
 - b. Certificates: Engineering certification that design criteria meets specified requirements.
 - c. Operating and Maintenance Instructions: Submit detailed maintenance requirements and operating instructions.
 - d. Warranty: Submit specified warranty documents.
6. Closeout Submittals:
 - a. Maintenance Data
 - b. Operation and maintenance data

1.03 QUALITY ASSURANCE

1. Manufacturer Qualifications: Obtain rolling shutters through one source from a single manufacturer with a minimum of 20 years experience in manufacturing products comparable to those specified in this section.

2. Installer Qualifications:
 - a. Use only manufacturer's factory trained installers or qualified installers approved by shutter manufacturer.
 - b.
3. Regulatory Requirements:
 - a. Comply with all local and governing code requirements.
 - b. Unless required otherwise, fabricate to withstand wind loads that carry same rating as component and cladding.
 - c.
4. Pre-Installation Conference: Conduct a pre-installation meeting to verify project installation and coordination requirements, and field conditions. Conference may be held via telephone conference call.

1.04 DELIVERY, STORAGE AND HANDLING

1. Deliver components in manufacturer's original, unopened, undamaged containers with identification labels intact. Store components protected from harmful weather conditions and damage from other construction activity.

1.05 PROJECT CONDITIONS

1. Field Measurements: Record actual measurements of openings before fabrication. Show recorded measurements on As-Built drawings.

1.06 WARRANTY

1. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by an authorized company official.
 - a. Warranty period: one year parts and labor, not including scaffolding, lifts, or other means to reach the inaccessible areas.

PART 2 - PRODUCTS

2.01 BASIS OF DESIGN MANUFACTURER

1. QMI
1661 Glenlake Avenue
Itasca, Illinois 60143 USA
phone: 00 1 630 529 7111 (800-446-2500)

2.02 Other Acceptable manufacturers

1. Substitutions: Not permitted.
2. Requests for substitutions will be considered in accordance with provisions of Section 01600.
3. Alternates: The following products and manufacturers may be bid as an alternate product in accordance with Section 01030. Any pricing for alternate products shall be listed separately from the base bid specified product. Any alternate pricing must include line-by-line compliance or non-compliance with the specifications. If the alternate product is acceptable to the Architect, the specified manufacturer will be given the opportunity to provide an equivalent proposal.
 - a. (list other mfr or product here)
 - b. (list other mfr or product here)

2.03 MATERIALS

1. Shutter Components:
 - a. Slat Type:
 - i. Aluminum Single Wall Slats: Extruded aluminum, 6063-T5 alloy. Solid slats with non-slip hinge. No perforated slip hinge slats allowed.
 1. End Retention: both ends of each slat to contain #10 x 3" truss head torx 410 stainless steel Dacromet-coated screws with shoulder bushings.
 2. Engineered roll-up with slat groupings increasing in size and radius to enable slats to nest around the drive tube to minimize housing size.
 - b. Bottom Slat: Extruded aluminum, 6063-T6 alloy, 0.050 inch wall thickness. Modular non-latching 2.05" base slat QMI-690-1 with rubber bottom gasket
 - i. Optional: Finger pull model QMI-691-1 integrated with base slat (with push up/pull down operation only).
 - ii. Key lock (lock CC) base slat with standard key engaging steel slides. Key lock on (non-box or box) side.
 - iii. Cylinder lock heavy duty base slat (with or without) thumb turn opposite key (centered or off-center at double doors) engaging steel slides. Key lock on (non-box or box) side.
 - iv. Motorized shutters do not require a lock since the motor maintains the shutter curtain in the down position. A separate locking base slat is not required. Provide non-latching QMI-690-1 base slat.
 - v. Gear operated shutters do not require a separate locking base slat. Provide non-latching QMI-690-1 base slat.
 - vi. EZ drive operated shutters do not require a separate locking base slat. Provide non-latching QMI-690-1 base slat.
 - c. Operation: (Manual) (110V Motor operated) (14.4V Low Voltage) (Motor operated).
 - i. Manual operator type: (choose one)
 1. Gear with hand crank: 11:1 drive end gearbox with wall or housing-mounted universal joint with 7mm hex input with (interior-through-the-wall) or (exterior-housing mounted) operation. Removable crank pole with articulating handle.
 2. Manual push up/pull down operation with internal drive tube torsion spring lift-assist manufactured to have maximum 35 lbs raise or lower effort.
 - d. End Caps: Die-cast Aluminum (square) (45 degree) (round) profile. Color to match slats
 - e. Box Cover (hood): Roll formed aluminum; .036 inch thickness, 3105-H14 alloy. Two-piece assembly-profile to match end caps. Color to match slats.
 - f. Track Guides/Side Rails: Compact, Aluminum extrusion, 6063-T5, lined with insulation woven polypropylene runners. Color to match slats. Aluminum extrusions; 6063-T6. Provide manufacturer's standard (3-5/8" retained only rail for motorized) or (4-1/4" retained and stop rail for manual crank or manual push up/pull down).
 - g. Mounting: (Jamb) (Surface/Face) (Build-out).
 - i. Face mount to sides of opening into building structure. No shutter shall be mounted to window frames.
 - ii. Build-out required at door openings (site specific) to clear door hardware.

- iii. Build-out required and mounted to building structure at trapped openings __ (site specific)_ for jamb mount. No build-out shall be attached to window frames.
- h. Vertical Stormbars: (specifier to choose i. or ii.)
 - i. Aluminum extrusions, 6005-T5 or 6063-T6 alloy. (3.0"), (4.0"), for (fixed) or (removable) application.
 - ii. Stormbars shall not be allowed in either fixed or removable mounts.)
- i. Drive Tube: Aluminum, 6063-T6 alloy – 70mm round with interior splines.

2.04 SHOP FINISH

1. Side Frames and Track: (Electrostatically applied - ESP - paint finish AAMA 2603).
2. Paint Color: (To match slats) (As selected by Architect).
3. Anodized selection only: 201-R1 Clear Acid Etch (15 min Velo) process that meets or exceeds all AAMA 611 specifications.

2.05 APPLICATION & DESIGN

1. Box Housing
 - a. Shape: shall be (square) (45°)(round).
 - b. Size: all shutters for project shall be contained in an (6", 6.5", 7", or 8") sized box housing. Sizes larger than (*insert largest housing size for project*)_” shall not be accepted. (*Specifier Note: please consult QMI engineering for precise Compact box housing size as shutter width may affect roll box size -delete this statement from final specification please*)
2. Locking Mechanism: Lock bar operation into mortised side rails at bottom of each side rail.
 - a. Key lock shall be on (box side or non-box side). Cylinder shall be (centered or off-center) at (single or double) doors.
 - b. Motorized shutters do not require a lock since the motor maintains the shutter curtain in the down position. A separate locking base slat is not required.
 - c. Gear operated shutters do not require a separate locking base slat.
 - d. EZ drive operated shutters do not require a separate locking base slat.
3. CODES: Installed shutters shall meet the required building compliance and documentation per section 1.02 SUBMITTALS.
 - a. IBC/IRC

PART 3 - EXECUTION

3.01 EXAMINATION

1. Verify conditions of substrates to determine if acceptable for shutter installation in accordance with manufacturer's instructions. Correct all unsatisfactory conditions prior to commencing shutter installations.

3.02 INSTALLATION

1. Install track and all shutter components to comply with project shop drawings and manufacturer's installation product approvals.
2. After installation, lubricate, test and adjust shutters to operate properly and free from distortion.

3.03 CLEANING

1. Clean installed components in accordance with manufacturer's instructions prior to Owner's acceptance. Properly remove from the site all debris remaining from this installation.

2. Inadequate surface cleaning will result in corrosion formation & potential structural damage.

3.04 PROTECTION

1. Comply with manufacturer recommendations and protect completed shutter installations from damage during remaining construction so as not to void warranty.

END OF SECTION

SECTION 085113 - ALUMINUM WINDOWS

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 aluminum windows for exterior locations.
- B. Related Requirements:
 - 1. Section 084113 "Aluminum-Framed Entrances" for coordinating finish among aluminum fenestration units.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 4. Dimensional tolerances of building frame and other adjacent construction.
 - 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
- B. Structural Loads:
 - 1. Wind Loads: 25 m.p.h.
- C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 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 mm), whichever is less.
- D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, 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. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation 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.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- G. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 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. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- I. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503.
- J. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having minimum STC 32 according to ASTM E 413 and an OITC 26 according to ASTM E 1332, as determined by testing according to ASTM E 90.
- 1.4 ACTION SUBMITTALS
- A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
1. Joinery.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- F. Welding certificates.
- G. Qualification Data: For Installer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- I. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- J. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
- K. Product Options: Information on Drawings and in Specifications establishes requirements for systems' 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 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.

- L. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."
- M. Products provided as part of this section must be manufactured by manufacturer of glazed aluminum curtain wall.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for aluminum-framed systems is based on Kawneer 8225TLF. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Vistawall Architectural Products.
 - 2. YKK AP America Inc.

2.2 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: AW.
 - 2. Minimum Performance Grade:40.
- C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 52.
- D. 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.

Differential values in "Temperature Change" Subparagraph below (for aluminum in particular) are suitable for most of the United States.

- 1. Temperature Change: 120 deg F (67 deg C) ambient.
- E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

2.3 ALUMINUM WINDOWS

- A. Basis-of-Design Product: The design for aluminum-framed systems is based on Kawneer 8225TLF. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Vistawall Architectural Products.
 - 2. YKK AP America Inc.
- B. Types: Provide the following types in locations indicated on Drawings:
 - 1. Hopper.
 - 2. Fixed.
- C. 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.

- D. Glass: Clear laminated glass, ASTM C1036, Type 1, Class 1, q3.
1. Kind: Laminated where indicated on Drawings.
- E. Insulating-Glass Units: ASTM E2190.
1. Glass: ASTM C1036, Type 1, Class 1, q3.
 - a. Tint: Clear.
 - b. Kind: Laminated.
 2. Lites: Two.
 3. Filling: Fill space between glass lites with argon.
 4. Low-E Coating: Pyrolytic on second surface.
- F. Glazing System: Laminated Insulated Glazing.
1. Dual Glazing System:
 - a. As specified in Division 8 Section "Glazing."
- G. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- H. 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: 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: Concealed multipoint lock operated by single lever handle or lift-type throw.
 4. Limit Devices: Concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening.
 - a. Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

Retain "Pole Operators" Subparagraph below if Project includes manually operated windows more than 72 inches (1800 mm) above floor. Electric operators are also available; if needed, insert requirements.

5. 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.
- I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

Generally, retain "Exposed Fasteners" Subparagraph below. Revise if exposed fasteners are permitted.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

- A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh-air vent, with a free airflow slot, full width of window sash by approximately [1 inch (25 mm)] [3 inches (75 mm)] when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.

Retain "Dividers (False Muntins)" Paragraph below if dividers are required. Indicate divider patterns on Drawings or insert requirements.

- B. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

Insert other accessories, such as nail fins, if required.

2.5 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 projected, awning.
- B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
 1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.

- C. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.

- 1. Wire-Fabric Finish: Charcoal gray.

2.6 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. 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.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" 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.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 085210 – SECURITY SCREENS

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. Window Security Screens

- B. Related Requirements:

- 1. Section 085113 "Aluminum Windows" for windows to receive security screen assemblies.
- 2. Section 099113 "Exterior Painting" for field painting exterior detention windows.

1.3 COORDINATION

- A. Coordinate installation of anchorages for security screens with windows, frames and openings. 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 masonry. Deliver such items to Project site in time for installation.

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 security screens.

- B. Shop Drawings: For window security screens.

- 1. Include plans, elevations, sections, and attachment details.
- 2. Full-size section details of framing members, and screens, reinforcement and stiffeners.
- 3. Hardware, including operators.

- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Main Framing Member: 12-inch- (305-mm-) long, full-size sections with factory-applied color finish.
 - 2. Hardware: Full-size emergency release latch with factory-applied finishes.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Manufacturer and Installer.
- B. Product Test Reports: For each type of window security screen, for tests performed by a qualified testing agency.
- C. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance data
- B. Operation and maintenance data.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace security window screens that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Failure of welds.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and detention use.
 - 2. Warranty Period: one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TESTING AND PERFORMANCE REQUIREMENTS

- A. Certifications - Performance and testing must comply with impact test, sag test and forced entry resistance test of SMA 6001-02. Manufacturer must submit the AAMA Notice of Product Certification in compliance with CFR 200.935 as "Security Screen - Heavy".

2.2 WINDOW SECURITY SCREENS

- A. Basis-of -Design
1. Manufacturer: Kane Architectural Innovations, Erie, PA
 2. Product: Subject to compliance with requirements, provide Model: S-NR5-O, Level 5, Heavy Vandalism Operable, Side hinged, Steel Narrowline Security Screens or a comparable product acceptable products manufactured by:
 - a. Graham Architectural Products
 - b. Peerless Products, Inc.
 - c. Traco Window Company.
- B. Main Frame:
1. The main frame rails shall be of not less than 16-gauge 1" x 1" seamless welded galvanized steel tubing with high strength die cast metal corners which are pneumatically inserted into the frame ends with an interference fit.
 2. A removable face plate, extruded from 6063-T6 aluminum alloy, .062-inch thick .212 lbs./ft., shall be attached to the sides of the main frame using square drive Tek screws. The faceplate corner bead shall integrate with the sub-frame to conceal the hardware and fasteners.
- C. Sub-Frame:
1. The sub-frame shall be of channel design, extruded from 6063-T6-aluminum alloy. Weight shall be .515 lbs./ft. Wall thickness shall be .090 inch. The corners of the subframe shall be mitered, secured by an internal tension coupling assembly and shall be resistant to both torsion and flexural failure.
 2. The sub-frame shall have a continuous groove retaining a combination cushioning strip/insect shield. The depth of the subframe shall be no more than 1 3/4".
- D. FINISH
1. The sub-frame, faceplates and scribe angles shall be thoroughly cleaned in a 5-step bonderizing process. An electrostatically applied thermoplastic, polyester powder coating (2.5 mil min. thickness) shall be applied and baked to a hard mar-resistant finish. Coating shall meet or exceed AAMA 2603.
 2. The main frame and infill shall be thoroughly cleaned in a 5-step bonderizing process. An electrostatically applied, thermoplastic, polyester powder coating (2.5 mil min. thickness) shall be applied and baked to a hard mar-resistant finish. Coating shall meet or exceed AAMA 2603.

E. INFILL

1. Perforated Panel: 18-gauge stainless steel with 63% open area

F. INFILL ATTACHMENT

1. The perforated panel shall be attached to the mainframe with hex-head Tek Screws.
2. Wire cloth shall be hemmed 180 degrees and retained by Hex-head Tek Screws. (for 12 mesh .028 wire cloth only)
3. Hex-head Tek screws shall penetrate the infill and main frame approximately 4" on center.

G. EMERGENCY EGRESS RELEASE

1. Each screen shall have two steel latches, which operate simultaneously from a Roto-Lift™ emergency release. The emergency release mechanism shall be contained within the tubular mainframe. Each Roto-Lift™ shall be outfitted with a secure spring-loaded activator to rotate the inhibitor, which allows the steel latches to open. When the Roto-Lift™ is activated the steel latches are simultaneously released and the screen opens for instant egress. No plastic parts will be accepted.
2. Each screen shall have a tamper shield installed at the emergency release to protect the screen hardware from exterior tampering.
3. Lock: Keyed cam lock to match existing keying, including key number on shop drawing submittal.

H. HARDWARE

1. Each screen shall be provided with two or more concealed 13-gauge, electroplated steel hinges with 1/4" diameter hardened, loose stainless steel pins and integral compression guards. 13-gauge stainless steel hinge available.
2. Each screen shall include adjustment screws (1/4-20 x 3/4 Philips pan head thread cutting fastener) and .062-inch thick aluminum scribes. The 1-3/16" x 3/4" scribes shall be supplied at the head and jambs if required.
3. Each screen shall come fully assembled and tested from the factory

2.3 MATERIALS:

1. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

4. 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.
5. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304 or 316.
6. Aluminum Extrusions: ASTM B221 (ASTM B221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength.
7. Steel Tubing: ASTM A513/A513M, Type B unless otherwise indicated; thickness indicated or required by structural loads.

2.4 FABRICATION

- A. General: Fabricate window security screens to provide a complete system for assembly of components and anchorage of units.
- B. 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.
- C. 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.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 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.

2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 2.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Color and Gloss: 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 for installation tolerances and other conditions affecting performance of window security screens.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install window security screens, plumb, rigid, properly aligned, and securely fastened in place, complying with Drawings, coordination drawings, and manufacturer's written instructions.
- B. Plumb and align faces in a single plane and erect screens square and true, adequately anchored to structure.
- C. Secure using security fasteners.

3.3 FIELD QUALITY CONTROL

- A. Remove and replace window security screens where work does not comply with specified requirements.

3.4 ADJUSTING

- A. Adjust operating hardware to provide a tight fit at contact points and for smooth operation.
- B. Remove and replace defective work, including windows security screens that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of detention windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
- B. Provide temporary protection to ensure that window security screens are without damage at time of Substantial Completion.

END OF SECTION 085210

SECTION 08 71 00
FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
1. Door hardware for steel (hollow metal) doors.
 2. Door hardware for aluminum doors.
 3. Door hardware for other doors indicated.
 4. Keyed cylinders as indicated.
- B. Related Sections:
1. Division 6: Rough Carpentry.
 2. Division 8: Aluminum Doors and Frames
 3. Division 8: Hollow Metal Doors and Frames.
 4. Division 26 Electrical
 5. Division 28: Electronic Security
- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
1. Builders Hardware Manufacturing Association (BHMA)
 2. NFPA 101 - Life Safety Code
 3. NFPA 80 - Fire Doors and Windows
 4. ANSI A156.1 - Butts and Hinges
 5. ANSI A156.2 - Bored and Preassembled Locks and Latches
 6. ANSI A156.3 - Exit Devices
 7. ANSI A156.4 - Door Controls - Closers
 8. ANSI A156.5 - Cylinders and Input Devices for Locks
 9. ANSI A156.6 - Architectural Door Trim
 10. ANSI A156.7 - Template Hinge Dimensions
 11. ANSI A156.8 - Door Controls – Overhead Stops and Holders
 12. ANSI A156.15 - Release Devices – Closer Holder, Electromagnetic & Electromechanical
 13. ANSI A156.16 - Auxiliary Hardware
 14. ANSI A156.18 - Materials and Finishes
 15. ANSI A156.21 - Thresholds
 16. ANSI A156.22 - Door Gasketing and Edge Seal Systems
 17. ANSI A156.23 - Electromagnetic Locks
 18. ANSI A156.25 - Electrified Locking Devices
 19. ANSI A156.28 - Recommended Practices for Mechanical Keying Systems
 20. ANSI A156.30 - High Security Cylinders
 21. ANSI-A117.1 – Accessible and Usable Buildings and Facilities 2009
 22. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances

1. Refer to Division 1 for allowance amount and procedures.

F. Alternates

1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

- A. Comply with Division 1.

1.3 SUBMITTALS:

- A. Comply with Division 1.

- B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

- C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

- D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.

7. Explanation of abbreviations and symbols used within schedule.
 8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.
- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.
- F. Samples: (If requested by the Architect)
1. 1 sample of Lever and Rose/Escutcheon design, (pair).
 2. 3 samples of metal finishes
- G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
1. Operating and maintenance manuals: Submit 3 sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 2. Copy of final hardware schedule, edited to reflect, "As installed".
 3. Copy of final keying schedule
 4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 110 volts.
 5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

- A. Comply with Division 1.
1. Statement of qualification for distributor and installers.
 2. Statement of compliance with regulatory requirements and single source responsibility.
 3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
 - a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
 - a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
 - b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

- B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Comply with Division 1.
 1. Deliver products in original unopened packaging with legible manufacturer's identification.
 2. Package hardware to prevent damage during transit and storage.
 3. Mark hardware to correspond with "reviewed hardware schedule".
 4. Deliver hardware to door and frame manufacturer upon request.
- B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

- A. Refer to Conditions of the Contract
- B. Manufacturer's Warranty:
 1. Closers: Thirty years
 2. Exit Devices: Five years
 3. Locksets: Ten years
 4. Cylinders: Three years

5. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

<u>Item:</u>	<u>Manufacturer:</u>	<u>Approved:</u>
Hinges	Stanley	Bommer, McKinney
Locksets	Best	Sargent, Schlage
Cylinders	Best	Sargent, Schlage
Exit Devices	Precision	Von Duprin
Closers	Dorma TS93	Norton 2800
Push/Pull Plates	Trimco	Burns, Rockwood
Push/Pull Bars	Trimco	Burns, Rockwood
Protection Plates	Trimco	Burns, Rockwood
Overhead Stops	ABH	Rixson, Glynn Johnson
Door Stops	Trimco	Burns, Rockwood
Flush Bolts	Trimco	ABH, Burns
Coordinator & Brackets	Trimco	ABH, Burns
Threshold & Gasketing	National Guard	Reese, K.N. Crowder

2.2 MATERIALS:

A. Hinges:

1. Template screw hole locations
 2. Minimum of 2 permanently lubricated non-detachable bearings
 3. Equip with easily seated, non-rising pins
 4. Sufficient size to allow 180-degree swing of door
 5. Furnish hinges with five knuckles and flush [concealed] bearings
 6. Provide hinge type as listed in schedule.
 7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
 8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
 9. UL10C listed for Fire rated doors.
- B. Electrified Functions for Hinges: Comply with the following:
1. Power Transfer: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle. Provide wire quantity and sizes required for electric hardware be served.
- C. Cylindrical Type Locks and Latchsets:
1. Tested and approved by BHMA for ANSI A156.2, Series 4000, Operational Grade 1, Extra-Heavy Duty, and be UL10C listed.
 2. Provide 9001-Quality Management and 14001-Environmental Management.
 3. Fit modified ANSI A115.2 door preparation.
 4. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
 5. Locksets to have anti-rotational studs that are thru-bolted
 6. Keyed lever shall not have exposed "keeper" hole
 7. Each lever to have independent spring mechanism controlling it
 8. 2-3/4 inch (70 mm) backset
 9. 9/16 inch (14 mm) throw latchbolt
 10. Provide sufficient curved strike lip to protect door trim
 11. Outside lever sleeve to be seamless, of one-piece construction made of a hardened steel alloy
 12. Keyed lever to be removable only after core is removed, by authorized control key
 13. Provide locksets with 7-pin removable and interchangeable core cylinders
 14. Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
 15. Locksets outside locked lever must withstand minimum 1400 inch pounds of torque. In excess of that, a replaceable part will shear. Key from outside and inside lever will still operate lockset.
 16. Core face must be the same finish as the lockset.
 17. Functions and design as indicated in the hardware groups.
- D. Exit Devices:
1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
 2. Exit devices to be tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
 3. Exit devices chassis to be investment cast steel, zinc dichromate.
 4. Exit devices to have stainless steel deadlocking 3/4" through latch bolt.

5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Non-fire rated exit devices to have ¼" minimum turn hex key dogging.
8. Touchpad to be "T" style constructed of architectural metal with matching metal end caps.
9. Touchbar assembly on wide style exit devices to have a ¼" clearance to allow for vision frames.
10. All exposed exit device components to be of architectural metals and "true" architectural finishes.
11. Provide strikes as required by application.
12. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
13. The strike is to be black powder coated finish.
14. Exit devices to have field reversible handing.
15. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
16. Provide 9001-Quality Management and 14001-Environmental Management.
17. Vertical Latch Assemblies to have gravity operation, no springs.

E. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

F. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1½" minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.

G. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

- H. Overhead Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.
1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
- I. Push Plates: Provide with four beveled edges ANSI J301, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.
- J. Pulls with plates: Provide with four beveled edges ANSI J301, .050 thickness Plates with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.
- K. Push Pull Bars: Provide ANSI J504, .1" Dia. Pull and push bar model and series as listed in hardware set. Provide proper fasteners for door construction.
- L. Kickplates: Provide with four beveled edges ANSI J102, 8 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- M. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- N. Door Bolts: Flush bolts for wood or metal doors.
1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
 2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
 3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
 4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.
- O. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
 2. Provide mounting brackets for soffit applied hardware.
 3. Provide hardware preparation (cutouts) for latches as necessary.
- P. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.
- Q. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
1. Weatherstrip shall be resilient seal of Neoprene, Polyurethane, Pile, Nylon Brush or Silicone as specified
 2. UL10C Positive Pressure rated seal set when required.

- R. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
 - 1. Door seal shall be resilient seal of Neoprene, Polyurethane, Nylon Brush or Silicone as specified
 - 2. UL10C Positive Pressure rated seal set when required.
- S. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½” for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.
- T. Provide one wall mounted Telkee, Lund or MMF series key cabinet complete with hooks, index and tags to accommodate 50% expansion. Coordinate mounting location with architect.
- U. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.3 FINISH:

- A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

- A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.
- B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.
- C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. Furnish keys in the following quantities:
 - 1. 1 each Grand Masterkeys
 - 2. 4 each Masterkeys

3. 2 each Change keys each keyed core
 4. 15 each Construction masterkeys
 5. 1 each Control keys
- F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.
- G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
 3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
 - 3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 DOOR HARDWARE SETS

- A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.
- C. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in this specification section as noted for each item.
- D. Manufacturer’s Abbreviations:
 - 1. ST - Stanley Works
 - 2. ST - dormakaba Door Closers
 - 3. ST - dormakaba Hinges
 - 4. MR - Markar
 - 5. FA - Falcon
 - 6. BE - dormakaba Best
 - 7. RO - Rockwood
 - 8. LC - LCN Closers

9. RE - Reese Enterprises Inc
10. OT - OTHER

Hardware Sets

Set: 1.0

Doors: 7.1

0	All Hardware	EXISTING TO REMAIN		OT
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Set: 2.0

Doors: 1.1, 1.2, 3.1

1	Continuous Hinge	HG305	630	MR
1	Mortise Exit Device	CD 25-M 511L SUT	US32D	FA
1	Cylinder (rim)	12E-72	626	BE
1	Cylinder (mortise)	1EK-7K4	626	BE
1	Surface Closer	4211 HCUSH	AL	LC
1	Armor Plate	K1062 36" x 1.5" LDW BEV	US32D	RO
1	Mop Plate	K1062 12" x .5" LDW BEV	US32D	RO
1	Threshold	234-280A 1/4-20 SSMSA		RE
2	Threshold	S247A		RE
1	Threshold	261A 10-24 SSMSA		RE
1	Gasketing	807A		RE
1	Rain Guard	R199A		RE
1	Sweep	353A		RE
1	Edge Guard	EGT308 86M	630	MR
1	Door Contact	GRI - 8080T	BL	OT
1	Junction Box	JB-2R	US2C	ST

Set: 3.0

Doors: 5.2, 6.2

1	Continuous Hinge	HG305	630	MR
1	Mortise Deadlock	49H7K K	630	BE
2	Push Pull	93-RKW	US32D	RO
1	Surface Closer	4211 HCUSH	AL	LC
1	Kick Plate	K1062 12" x 1.5" LDW BEV	US32D	RO
1	Armor Plate	K1062 36" x 1.5" LDW BEV	US32D	RO

MILES MACK BUILDING RENOVATION

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1	Threshold	234-280A 1/4-20 SSMSA	RE
1	Threshold	S247A	RE
1	Threshold	261A 10-24 SSMSA	RE
1	Gasketing	807A	RE
1	Rain Guard	R199A	RE
1	Sweep	353A	RE
1	Edge Guard	EGT308 86M	630 MR
1	Door Contact	GRI - 8080T	BL OT
1	Junction Box	JB-2R	US2C ST

Set: 4.0

Doors: 3.2

6	Hinge	HT CB1961RNRP 4-1/2" x 4-1/2"	US26D ST
1	Mullion	KR 4023	SP28 FA
1	Rim Exit Device	25-R EO	US32D FA
1	Rim Exit Device	25-R 511L SUT	US32D FA
1	Cylinder (rim)	12E-72	626 BE
1	Cylinder (mortise)	1E-74	626 BE
2	Surface Closer	4211 EDA	AL LC
2	Wall Stop	403	US26D RO
2	Silencer	608-RKW	RO

Set: 5.0

Doors: 8.1

3	Hinge	HT CB1961RNRP 4-1/2" x 4-1/2"	US26D ST
1	Classroom Lock	9K37R 15D S3	626 BE
1	Kick Plate	K1062 12" x 1.5" LDW BEV	US32D RO
1	Wall Stop	403	US26D RO
3	Silencer	608-RKW	RO

Set: 6.0

Doors: 10.1

3	Hinge	HT CB1961RNRP 4-1/2" x 4-1/2"	US26D ST
1	Dormitory Lock	9K37T 15D S3	626 BE
1	Surface Closer	4211 EDA	AL LC
1	Kick Plate	K1062 12" x 1.5" LDW BEV	US32D RO
1	Mop Plate	K1062 12" x .5" LDW BEV	US32D RO

MILES MACK BUILDING RENOVATION

February 7, 2020

1	Wall Stop	403	US26D	RO
3	Silencer	608-RKW		RO
1	Sign (Unisex, ADA)	BF689	US26D	RO

Set: 7.0

Doors: 5.1, 6.1

3	Hinge	HT CB1961RNRP 4-1/2" x 4-1/2"	US26D	ST
1	Deadbolt	8T37L S5 CS	626	BE
1	Push Pull	93-RKW	US32D	RO
1	Surface Closer	4211 HCUSH	AL	LC
1	Kick Plate	K1062 12" x 1.5" LDW BEV	US32D	RO
1	Mop Plate	K1062 12" x .5" LDW BEV	US32D	RO
1	Wall Stop	403	US26D	RO
3	Silencer	608-RKW		RO
1	Sign (Men / Women)	BF684 / BF685	US26D	RO

Set: 8.0

Doors: 9.1

3	Hinge	HT CB1961RNRP 4-1/2" x 4-1/2"	US26D	ST
1	Deadbolt	8T37S S1	626	BE
1	Push Pull	93-RKW	US32D	RO
1	Mop Plate	K1062 12" x .5" LDW BEV	US32D	RO
1	Wall Stop	403	US26D	RO
3	Silencer	608-RKW		RO

END OF SECTION 087100

SECTION 088000 - GLAZING

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. Glass for windows, doors, storefront framing.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
 - 1. Insulating glass.

- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Product Test Reports: For insulating glass, for tests performed by a qualified testing agency.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

- A. 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: 10 years from date of Substantial Completion.

- B. 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

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 1. Obtain tinted glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

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. 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: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. 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.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- B. Heat-Strengthened Float Glass: ASTM C 1048, 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.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

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 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.

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 E 2190.
1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 2. Spacer: Manufacturer's standard spacer material and construction.
 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

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 selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

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 C 1281 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. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units 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.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 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).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- 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.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 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. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. 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.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 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.

3.6 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.

3.7 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.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Fully tempered float glass.

- 1. Minimum Thickness: 6 mm .
- 2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

- A. Glass Type GL 1: Clear laminated glass with two plies of heat-strengthened float glass.

- 1. Minimum Thickness of Each Glass Ply: 6MM.
- 2. Interlayer Thickness: 0.030 inch.

- B. Glass Type GL-2: Clear fully tempered float glass.

- 1. Minimum Thickness: 6 mm.
- 2. Safety glazing required.

- C. Low-E-Coated, Clear insulating glass.

- 1. Overall Unit Thickness: 1 inch (25 mm).
- 2. Minimum Thickness of Each Glass Lite: 6 mm.
- 3. Outdoor Lite: Clear Laminated Glass GL-1.
- 4. Interspace Content: Argon
- 5. Indoor Lite: Fully tempered float glass GL-2.
- 6. Low-E Coating: Pyrolytic on second.
- 7. Safety glazing required.

END OF SECTION 088000

SECTION 089119 - LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers.
- B. Related Sections:
 - 1. Division 4 Section "Unit Masonry Assemblies" for building wall vents (brick vents) into masonry.
 - 2. Division 8 Section "Steel Doors and Frames" for louvers in hollow-metal doors.
 - 3. Division 15 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural 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 a uniform pressure of 20 lbf/sq. ft., acting inward or outward.
 2. Wind Loads: Determine loads based on pressures indicated below:
 - a. Corner Zone: Within 10 feet of building corners, uniform pressure of <Insert design wind pressure>, acting inward, and <Insert design wind pressure>, acting outward.
 - b. Other Than Corner Zone: Uniform pressure of <Insert design wind pressure>, acting inward, and <Insert design wind pressure>, acting outward.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
1. Temperature Change (Range): 120 deg F.
- D. 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.
- 1.5 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. 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. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
 3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.
 - C. Samples for Initial Selection: For units with factory-applied color finishes.
 - D. Samples for Verification: 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.
 - F. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
 - B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- D. 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.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use 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.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, 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 E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
 - C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
 - D. 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.
 1. Frame Type: Channel unless otherwise indicated.
 - E. Include supports, anchorages, and accessories required for complete assembly.
 - F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.
 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with mullions at corners.
 - G. Provide extended sills for recessed louvers.
 - H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
- 2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS
- A. Horizontal Storm-Resistant Louver:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Greenheck Fan Corporation.
 - i. Industrial Louvers, Inc.
 - j. NCA Manufacturing, Inc.
 - k. Nystrom Building Products.
 - l. Reliable Products, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 2. Louver Depth: 4 inches
 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and 0.080 inch for frames.
 4. Louver Performance Ratings:

- a. Free Area: Not less than 8.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
 - b. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area intake velocity.
 - c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 400 fpm.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 2. Finish: Same finish as louver frames to which louver screens are attached.
 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

- A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.
1. Thickness: 1 inch.
 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
 3. Insulating Core: Rigid, glass-fiber-board insulation.
 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch, with corners mitered and with same finish as panels.
 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 6. Panel Finish: Same finish applied to louvers.
 7. Attach blank-off panels with sheet metal screws.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 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: Custom color to match material in wall where louver is set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents 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. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be 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.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents 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.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 10200

SECTION 090190.52 - MAINTENANCE REPAINTING

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 maintenance repainting as follows:

- 1. Removing existing paint.
- 2. Patching substrates.
- 3. Repainting.

- B. Related Requirements:

- 1. Section 040110 "Masonry Cleaning" for cleaning and removing paint from masonry.
- 2. Section 099113 "Exterior Painting," Section 099123 "Interior Painting," Section 099300 "Staining and Transparent Finishing," and Section 099600 "High-Performance Coatings" for paint materials and systems for new construction.

1.3 DEFINITIONS

- A. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
- C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 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 SEQUENCING AND SCHEDULING

- A. Perform maintenance repainting in the following sequence, which includes work specified in this and other Sections:
 - 1. Dismantle existing surface-mounted objects and hardware 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 surfaces to be painted.
4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
5. Apply paint system.
6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.6 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. Samples: For each type of paint system and each pattern, color, and gloss; minimum 6 inches (150 mm) long in least dimension, but not less than whole pattern.

1. Include stepped Samples defining each separate coat, including fillers and primers. Resubmit until each required sheen, color, and texture is achieved.
2. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
3. Include a list of materials for each coat of each Sample.
4. Label each Sample for location and application.

C. Product List: For each paint product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each MPI-product category specified in paint systems, with the proposed product highlighted.
3. VOC content.

1.7 INFORMATIONAL SUBMITTALS

A. Color Matching Certificate: For computer-matched colors.

B. Preconstruction Test Reports: For cleaning materials, paint removers and paint coatings and systems.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra paint materials, from the same production run, that match products applied and that are packaged with protective covering for storage and identified with labels describing contents, including material, finish, source, and location on building.

1. Quantity: Furnish Owner with an additional 5 percent, but not less than 1 gal. (3.8 L) or one case, as appropriate, of each material and color applied.

1.9 QUALITY ASSURANCE

- A. Color Matching: Custom computer-match paint colors to colors indicated 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.

1.10 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing of cleaning materials, paint removers and compatibility of paint coatings and systems for each indicated type of painted surface.
 - 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 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste daily.

1.12 FIELD CONDITIONS

- A. Weather Limitations: Proceed with maintenance repainting only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- B. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer for surface preparation and during paint application and drying periods.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

- A. Water: Potable.

- B. 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.
- C. 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.
- D. 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.

2.2 PAINT REMOVERS

- A. 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Building Restoration Products, Inc.
 - b. Cathedral Stone Products, Inc.
 - c. Dumond Chemicals, Inc.
 - d. EaCo Chem, Inc.
 - e. PROSOCO, Inc.

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 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. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 50 g/L.
 3. Dry-Fog Coatings: 150 g/L.
 4. Primers, Sealers, and Undercoaters: 100 g/L.
 5. Rust-Preventive Coatings: 100 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Clear Wood Finishes, Varnishes: 275 g/L.
 9. Clear Wood Finishes, Lacquers: 275 g/L.
 10. Floor Coatings: 50 g/L.
 11. Shellacs, Clear: 730 g/L.
 12. Shellacs, Pigmented: 550 g/L.
 13. Stains: 100 g/L.
- C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the 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."
- D. 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

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Benjamin Moore & Co.; products as designated in "Paint Material" article below or comparable products by one of the following:
1. Behr Process Corporation.
 2. Glidden Professional.
 3. PPG Architectural Coatings.
 4. Sherwin-Williams Company (The).
 5. Valspar Corporation - Architectural (Pro), a Sherwin-Williams Company.

2.6 PAINT MATERIALS

- A. Primers and Sealers:
1. Primer Sealer, Latex, Interior
 - a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).

- e. Valspar Corporation - Architectural
2. Primer, Latex, for Interior Wood:
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation - Architectural
- B. Metal Primers:
1. Primer, Metal, Surface Tolerant:
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation - Architectural .
2. Primer, Alkyd, Anti-Corrosive for Metal:[**MPI #79.**]
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation - Architectural .
- C. Water-Based Paints:
1. Latex, Exterior Flat (Gloss Level 1
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation - Architectural
2. Latex, Exterior Low Sheen (Gloss Levels 3-4):
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation Architectural
3. - Latex, Exterior Semigloss (Gloss Level 5)
- a. Behr Process Corporation.
 - b. Glidden Professional.

- c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation Architectural
4. Latex, Exterior, Gloss (Gloss Level 6)
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation Architectural
5. Latex, Interior Flat (Gloss Level 1)
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation - Architectural
6. Latex, Interior Low Sheen (Gloss Levels 3-4):
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation Architectural
7. - Latex, Interior Semigloss (Gloss Level 5)
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation Architectural
8. Latex, Interior, Gloss (Gloss Level 6)
- a. Behr Process Corporation.
 - b. Glidden Professional.
 - c. PPG Architectural Coatings.
 - d. Sherwin-Williams Company (The).
 - e. Valspar Corporation Architectural

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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abatron, Inc.
 - b. Advanced Repair Technology, Inc.
 - c. ConServ Epoxy LLC.
 - d. Gougeon Brothers, Inc.
 - e. Polymeric Systems, Inc.
 - f. Protective Coating Company.
 - g. System Three Resins, Inc.
 - h. <Insert manufacturer's name>.
- 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 C 842 and manufacturer's written instructions.

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 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 the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. 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 and collect 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.

3.2 MAINTENANCE REPAINTING, GENERAL

- A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet (1.5 m) away from painted surface and from building exterior at 20 feet (6 m) away from painted surface.
- B. 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.
- C. 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.
- D. Heat Processes: Do not use torches, heat guns, or heat plates.

3.3 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 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.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

1. If existing surfaces cannot be prepared to an acceptable condition for proper finishing by using specified surface-preparation methods, notify Architect in writing.
- E. 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.

3.4 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.

3.5 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. 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: 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.
 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 (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 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. Repeat process if necessary to remove all paint.

- D. 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 surface 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.

3.6 PAINT APPLICATION, GENERAL

- A. Comply with manufacturers' written instructions for application methods unless otherwise indicated in this Section.
- B. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.
- C. Apply a transition coat over incompatible existing coatings.
- D. 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.
- E. 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 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. 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.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 090190.52

SECTION 092900 - GYPSUM BOARD

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 gypsum board.
- 2. Exterior gypsum board for sheathing and soffits.

B. Related Requirements:

- 1. Section 09111 "Non-Load-Bearing Steel Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 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.

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corp.
 - 2. National Gypsum Company.
- B. Gypsum Ceiling Board: ASTM C1396/C1396M. Install over plywood mounted on suspension system per details on drawings.
 - 1. Thickness: 1/2 inch (12.7 mm).
 - 2. Long Edges: Tapered.

2.3 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet.
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.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
- 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. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 2. Fill Coat: For second coat, use drying-type, all-purpose compound.
 3. Finish Coat: For third coat, use drying-type, all-purpose compound.
 4. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- 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.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: 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.
- B. Control Joints: Install control joint according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.
 3. U-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09912 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 096623 - RESINOUS 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. Section Includes:

- 1. Thin-set, epoxy-resin flooring with integral base.
- 2. Broadcast aggregates.

B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 5 inches (150 mm) square, applied to a rigid backing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in- service performance, and who is acceptable to resinous flooring manufacturer.
 - 2. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated. Contractor shall have completed at least 10 projects of similar size and complexity.
 - 3. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
 - 4. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
 - 5. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- 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 for terrazzo including accessories.
 - a. Size: Minimum 10 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.

- b. Include base.
- 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
 - 1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after 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 not less than 24 hours after application, unless manufacturer recommends a longer period.
- D. Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring

1.10 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include
1. Must comply with double broadcasting build. Liquid rich, slurry type systems will not be accepted, and will result in a disqualification from bid.
- B. Acceptable Manufactures
1. Stonhard Basis of design:
- C. Products: Subject to compliance with requirements:
1. Stonhard, Inc.; Stonshield URT®.
- D. System Characteristics:
1. Color and Pattern: Choose from Mfg. Standards
 2. Wearing Surface: Standard, or medium.
 3. Integral Cove Base: TBD.
 4. Overall System Thickness: nominal 2mm.
- E. System Components: Manufacturer's standard components that are compatible with each other and as follows:
1. Primer:
 - a. Material Basis: Stonhard Quik Primer
 - b. Resin: Aromatic urethane.
 - c. Formulation Description: (2) two component.
 - d. Application Method: Squeegee and roller.
 - e. Number of Coats: (1) one.
 2. Broadcast Media:
 - a. Material Basis: Stonshield quartz aggregate.
 - b. Type: pigmented.
 - c. Finish: standard.
 - d. Number of Coats: one.
 - e. Pattern: Tweed.
 3. Undercoat:
 - a. Material Basis: Stonshield URT Undercoat.
 - b. Resin: Urethane.
 - c. Formulation Description: (2) two-component, Solvent free, UV resistant, Aliphatic urethane.

- d. Type: Clear.
 - e. Number of Coats: one.
4. Broadcast Media:
- a. Material Basis: Stonshield quartz aggregate
 - b. Type: pigmented.
 - c. Finish: standard.
 - d. Number of Coats: one.
 - e. Pattern: Tweed.
5. Sealer:
- a. Material Basis: Stonseal CA7.
 - b. Resin: Urethane.
 - c. Formulation Description:(2) two-component, Solvent free, UV resistant, Aliphatic urethane.
 - d. Type: Clear.
 - e. Finish: Gloss.
 - f. Number of Coats: one.
 - g. Texture level: Standard or medium.

Note: Components listed above are the basis of design intent; all bids will be compared to this standard including resin chemistry, color, wearing surface, thickness, and installation procedures, including number of coats. Contractor shall be required to comply with all the requirements of the Specifications and all of the components required by the Specifications, whether or not such products are specifically listed above.

- F. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
- 1. Tensile Strength / Undercoat: 4,800 psi per ASTM D 638.
 - 2. Tensile Strength / Sealer: 6,000 psi per ASTM D 638.
 - 3. Hardness: 60 per ASTM D 2240, Shore D
 - 4. Impact Resistance: > 160 in. lbs. per ASTM D 2794.
 - 5. Abrasion Resistance: 0.10 gm max. weight loss per ASTM D 4060, CS-17
 - 6. Thermal Coefficient of Linear Expansion: 1.2×10^{-5} in/in °F
 - 7. Cure Rate: 3 to 4 Hours for foot traffic, 12 hours normal operations
 - 8. Flammability: Class 1 per ASTM E-648.
 - 9. VOC Content:
 - a. Quik Primer – 89 g/l
 - b. Stonshield URT Undercoat – 22 g/l
 - c. Stonseal CA7 – 100 g/l

2.2 ACCESSORY MATERIALS

- A. Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated
- B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph 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. Mechanically prepare 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, or Diamond Grind with a dust free system.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 - 3. Verify that concrete substrates are dry.
 - a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 80 percent.
 - b. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab in 24 hours.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

- C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- D. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material.

3.3 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Integral Cove Base: Stonshield cove mortar, apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, of cove base. Round internal and external corners.
 - 1. Integral Cove Base: See Drawings for dimensions.
- C. Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
- D. Broadcast: Immediately broadcast quartz silica aggregate into the primer using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.
- E. Undercoat: Remove any surface irregularities by lightly abrading and vacuuming the floor surface. Mix and apply undercoat with strict adherence to manufacturer's installation procedures and coverage rates.
- F. Broadcast: Immediately broadcast quartz silica aggregate into the undercoat using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.
- G. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.4 TERMINATIONS

- A. Chase edges to “lock” the flooring system into the concrete substrate along lines of termination.
- B. Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.5 JOINTS AND CRACKS

- A. Treat control joints to bridge potential cracks and to maintain monolithic protection.
- B. Treat cold joints and construction joints cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- C. Vertical and horizontal contraction and expansion joints are treated by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.6 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.7 CLEANING, PROTECTING, AND CURING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations

for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.

- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General contractor is responsible for cleaning prior to inspection.

END OF SECTION 096723

SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Concrete masonry units (CMUs).
 - 2. Galvanized metal.
 - 3. Wood.
 - 4. Plastic.
 - 5. Gypsum board.

1.3 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.

1.4 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.

2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product by one of the following:
1. Benjamin Moore & Co.
 2. PPG Architectural Finishes, Inc.

3. Sherwin-Williams Company (The).

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 selected by Architect from manufacturer's full range.

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. Masonry (Clay and CMUs): 12 percent.
 2. Wood: 15 percent.
 3. Gypsum Board: 12 percent.
- C. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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.
- C. Clean substrates of substances that could impair bond of paints, 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 paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- F. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 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.
- G. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. 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. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. 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.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Latex over Alkali-Resistant Primer System:
 - a. Prime Coat: Primer, alkali resistant, water based.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5).
- B. Galvanized-Metal Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, galvanized, cementitious.
 - b. Prime Coat: Primer, galvanized, water based.
 - c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5).
- C. Wood Substrates: Wood trim and Architectural woodwork.

1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, alkyd for exterior wood.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5).

D. Plastic Trim Fabrication Substrates:

1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, bonding, water based.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5).

E. Exterior Gypsum Board Substrates:

1. Latex System:
 - a. Prime Coat: Primer, latex for exterior wood (reduced).
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:

- 1. Concrete masonry units (CMUs).
- 2. Steel and iron.
- 3. Galvanized metal.
- 4. Wood.
- 5. Gypsum board.

- B. Related Requirements:

- 1. Division 5 Section "Metal Fabrications" for shop priming metal fabrications.
- 2. Division 5 Section "Pipe and Tube Railings" for shop priming painting pipe and tube railings.
- 3. Division 9 Section "High-Performance Coatings" for tile-like coatings.

1.3 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.

1.4 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.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
1. Benjamin Moore & Co.
 2. PPG Architectural Finishes, Inc.
 3. Sherwin-Williams Company (The).

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 selected by Architect from manufacturer's full range.

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. Masonry (Clay and CMUs): 12 percent.
 2. Wood: 15 percent.
 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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.
- C. Clean substrates of substances that could impair bond of paints, 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 paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer. but not less than the following:
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Wood Substrates:
 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view, and dust off.
 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.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. 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. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. 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.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
1. High-Performance Architectural Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior.
 - b. Prime Coat: Primer, alkali resistant, water based

- c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - d. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- B. Steel Substrates:
- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- C. Galvanized-Metal Substrates:
- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, galvanized, water based.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- D. Wood Substrates: Wood trim Architectural woodwork.
- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- E. Gypsum Board Substrates:
- 2. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

- c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3.

END OF SECTION 099123

SECTION 101100 - VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of visual display boards:
 - 1. Porcelain enamel markerboards.
 - 2. Natural cork tackboards.
 - 3. Flag holds, chalk holders, map rails, display rails.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 6 Section "Rough Carpentry" for wood blocking and grounds.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Include motor capacities, and individual panel weights for sliding markerboard or markerboard units. Include manufacturer's data substantiating that tackboard materials comply with requirements indicated.
- C. Shop Drawings: Provide shop drawings for each type of markerboard, markerboard, and tackboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
- D. Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color, pattern, and texture:
 - a. Porcelain Enamel Markerboard: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of markerboard and markerboard required.
 - b. Aluminum Trim and Accessories: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available. This sample is to show the rounded chalktray end.

2. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated.
 - a. Markerboards and Tackboards: Sample panels not less than 8-1/2 inches by 11 inches for each type of markerboard and tackboard indicated. Include a sample panel for each color, texture, and pattern required.
 - b. Aluminum Trim and Accessories: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate. Where finishes involve normal color and texture variations, include sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is an authorized representative of the markerboard manufacturer for both installation and maintenance of the type of sliding markerboard units required for this Project.
 1. Maintenance Proximity: Not more than 4 hours' normal travel time from the Installer's place of business to the Project site.
- B. Fire Performance Characteristics: Provide tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
 1. Flame Spread: 25 or less.
 2. Smoke Developed: 10 or less.
- C. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of visual display boards. Other visual display boards having equal performance characteristics with deviations from indicated dimensions and profiles may be considered provided deviations do not change the design concept or intended performance.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.
 1. Allow for trimming and fitting wherever taking field measurements before fabrication might delay the Work.

1.6 WARRANTY

- A. Porcelain Enamel Markerboard Warranty: Furnish the manufacturer's written warranty, agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing

qualities, become slick and shiny, or exhibit crazing, cracking, or flaking, provided the manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.

1. Warranty Period: 25 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 1. Porcelain Steel Markerboards (fixed):
 - a. "Projection Plus Board" by Best-Rite Manufacturing, or approved equal.
 2. Manufactured Cork Tackboards:
 - a. Polyvision or equal.
 - b. Claridge Products and Equipment, Inc.
 - c. Best-Rite Manufacturing.

2.2 MATERIALS

- A. Porcelain Steel Markerboards: Provide Porcelain Steel surface as manufactured by Best-Rite.
- B. Plastic-Impregnated Cork Sheet: MS MIL-C-15116-C, Type I, seamless, homogenous, 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.

2.3 TACK ASSEMBLIES

- A. Plastic-Impregnated-Cork Tack Assembly: ¼" (6 mm) thick, plastic-impregnated cork sheet factory laminated to ¼" (6 mm) thick hardboard backing.

2.4 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.

1. Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Architect from the manufacturer's standard structural support accessories to suit the condition indicated.
2. Factory-Applied Trim: Provide the manufacturer's standard integral trim, with no visible screws or exposed joints.
3. Chalktray: Manufacturer's standard, continuous, box-type, aluminum chalktray with slanted front and cast-aluminum radiused and rounded end closures for each markerboard.
4. Map Rail: Furnish map rail at the top of each unit, complete with the following accessories:
 - a. Display Rail: Provide continuous cork display rail approximately 1 or 2 inches wide, as indicated, integral with the map rail.
 - b. End Stops: Provide one end stop at each end of the map rail.
 - c. Map Hooks: Provide 2 map hooks with flexible metal clips for each 4 feet of map rail or fraction thereof.
 - d. Flagholders: Provide two flagholders for each room.
5. Tack Strip: Provide continuous tack strip approximately 2 inches wide with locations as indicated on the drawings.

2.5 FABRICATION

- A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- B. Assembly: Provide factory-assembled markerboard and tackboard units, except where field-assembled units are required.
 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect.
 2. Provide the manufacturer's standard vertical joint system between abutting sections of markerboard.
 3. Provide manufacturer's standard mullion trim at joints between markerboard and tackboard.

2.6 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II Clear Anodized Finish: AA-M12C22A31 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Deliver factory-built markerboard and tackboard units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, prefabricate components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- B. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for a complete installation.
- C. Coordinate job-site assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.2 ADJUST AND CLEAN

- A. Verify that accessories required for each unit have been properly installed.
- B. Clean units in accordance with the manufacturer's instructions. Break in markerboards only as recommended by the manufacturer.

END OF SECTION 101100

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

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 Aluminum Letters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. 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 One Quarter scale.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Dimensional Characters: Half-size Sample of each type of dimensional character.
 - 2. Exposed Accessories: Full-size Sample of each accessory type.
- D. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

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 signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: 90 mph.
 - 2. Concentrated Horizontal Load: 40 psf.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
- B. 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.

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 aluminum.
 - 2. Character Height: As indicated on Drawings.
 - 3. Thickness: Manufacturer's standard for size of character.

4. Finishes:
 - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
5. Mounting: Concealed studs.
6. Typeface: Arial

2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

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 stainless-steel devices unless otherwise indicated.
 3. 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.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. 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 connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. 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.
7. 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.

2.6 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.

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.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

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. Room-identification signs.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. 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 others, and accessories.
 - 3. Show message list, tpestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available tpestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
 - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.

- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. 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 U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Ace Sign Systems, Inc.

2. Advance Corporation; Braille-Tac Division.
3. Allen Industries, Inc.
4. Allen Markings International.
5. ASE, Inc.
6. ASI Sign Systems, Inc.
7. Best Sign Systems Inc.
8. Bunting Graphics, Inc.
9. Clarke Systems.
10. Diskey Sign Company.
11. Fossil Industries, Inc.
12. InPro Corporation.
13. Mohawk Sign Systems.
14. Nelson-Harkins Industries.
15. Poblocki Sign Company, LLC.
16. Seton Identification Products.
17. Supersine Company (The); Division of Stamp-Rite, Inc.
18. Vista System.
19. Vomar Products, Inc.

B. Room-Identification 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. Basis-of-Design Product: IM System/Sign Match, ADA-Compliant, with insert slot component by APCO Graphics, Inc. or approved equal.
2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet
3. Mounting: Manufacturer's standard method for substrates indicated.
4. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 PANEL-SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.
- E. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

- F. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.
- G. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Internally brace signs for stability and for securing fasteners.

2.6 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.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface 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 signage work.

- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 102113.14 - STAINLESS-STEEL TOILET COMPARTMENTS

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 stainless-steel toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Requirements:
 - 1. Division 10 Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

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 toilet compartments.
- B. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of reinforcements for compartment-mounted grab bars and locations of blocking for surface-mounted toilet accessories.
 - 4. Show locations of centerlines of toilet fixtures.
 - 5. Show locations of floor drains.
 - 6. Show ceiling-mounted items, and overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of toilet compartment material indicated.
 - 1. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 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. Door Hinges: Two hinge(s) with associated fasteners.
 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
 3. Door Bumper: One door bumper(s) with associated fasteners.
 4. Door Pull: One door pull(s) with associated fasteners.
 5. Fasteners: Ten fasteners of each size and type.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

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. Manufacturers: subject to compliance with requirements, Provide products by one of the following.
 1. American Sanitary Partition corporation.
 2. Ampco Products, LLC.
 3. Bradley corp.
 4. General Partitions mfg. corp.

5. Global partitions: ASI Group
- B. Toilet-Enclosure Style: Ceiling hung.
 - C. Urinal-Screen Style: Ceiling hung with integral flanges.
 - 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 F 446, 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. Integral-Flange, Ceiling-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches (32 mm) thick.
 2. 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, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch (1.27 mm).
 2. Panels: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
 3. Doors: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
 4. Integral-Flange, Ceiling-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 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. Brackets (Fittings):
 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel .
 - I. Stainless-Steel Finish: No. 4 bright, directional polish 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 heavy-duty operating hardware and accessories.
1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless steel continuous, cam type that swings to a closed or partially open position allowing emergency access by lifting door. Mount with through-bolts.
 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. 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. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 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. 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.
- C. 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 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. 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.
- B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 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 to return doors to fully closed position.

END OF SECTION 102113.14

SECTION 102800 – TOILET AND BATH ACCESSORIES

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. Washroom accessories.
 - 2. Shower room accessories.
 - 3. Bathroom accessories.
 - 4. Custodial accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- 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.

1.7 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and 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 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

- A. Refer to schedules on drawings for toilet accessories.

2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. 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 units 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, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104416 - FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

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. Failures include, but are not limited to, the following:

- a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
2. 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.
 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
 1. Manufacturers: subject to compliance with requirements provide products by one of the following.
 - a. Babcock-Davis
 - b. Fire End & Croker corp.
 - c. Guardian fire Equipment, Inc.
 - d. JL Industries, Inc.
 - e. Larsens Manufacturing Company
 - f. MOON American.
 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 3. Valves: Manufacturer's standard.
 4. Handles and Levers: Manufacturer's standard.
 5. 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. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: 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 baked-enamel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105613 – METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the contract, including general and supplementary conditions and related specification sections, apply to this section.

1.2 SUMMARY

- A. This section includes the following:

Metal Shelving

1.3 REFERENCES

- A. American National Standards Institute (ANSI) Standards
- B. American Society for Testing and Materials (ASTM) Standards

1.4 DESCRIPTION

- A. General: Wall Hung Metal Shelving
- B. Finishes:
 - 1. Metal Components and Accessories: All shelving components including accessories shall be Bright Stainless Steel No.4.
- C. Sizes: Per manufacturer's standard offering as shown on Drawings.

1.5 PERFORMANCE REQUIREMENTS

- A. Design Requirements:
 - 1. Consult drawing for plan view and elevation details. Provide vertical stainless steel support standards with wall anchors at intervals recommended by manufacturer to support 125lb/lf.
 - 2. Available in nominal widths of 24 inches (610 mm), 30 inches (762 mm), 36 inches (914 mm), 42 inches (1067 mm), and 48 inches (1219 mm).
 - 3. Available in nominal depths of 12 inches (305 mm), 13 inches (330 mm), 15 inches (381 mm), 16 inches (406 mm), 18 inches (457 mm), 24 inches (610 mm), 26 inches (660 mm), 30 inches (762 mm), 32 inches (813 mm), and 36 inches (914 mm).

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product literature and installation instructions.
 - B. Drawings: Provide layout of shelving including notations and descriptions. Provide dimensional drawings of all shelving quoted.
 - C. Warranty: Submit a copy of manufacturer's warranty.
 - D. Maintenance Data: Provide manufacturer's instructions for care and cleaning of the finish. Provide manufacturer's instructions for shelf relocation and/or spacing adjustments.
 - E. Reference List: Provide list of recently installed similar type of shelving projects.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Engage an experienced manufacturer who has been manufacturing this type of shelving continuously at the same location for a period of not less than 50 years.
 - B. Manufacturing Qualifications: Engage an experienced manufacturer whose internal processes meet or exceed ISO 9001 requirements.
- 1.8 DELIVERY, STORAGE AND HANDLING
- A. Follow manufacturer's instructions and recommendations for delivery, storage and handling requirements.
- 1.9 PROJECT CONDITIONS
- A. Field Measurements: Verify quantities of wall hung shelving units before fabrication. Indicate verified measurements on shop drawings. Coordinate fabrication and delivery to ensure no delay in progress of the work.
 - B. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating wall hung shelving units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.
- 1.10 SEQUENCING AND SCHEDULING
- A. Sequence shelving units with adjoining work to minimize possibility of damage and soiling during remainder of construction period.
 - B. Schedule installation of specified shelving after finishing operations; including painting have been completed.

- C. Delivery, Storage, and Handling: Comply with all instructions and recommendations made by manufacturer or manufacturer's representative for delivery, storage, and handling requirements.

1.11 WARRANTY

- A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units, which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the owner may have under general conditions provisions of the contract documents.
- B. Limited Lifetime warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the shelving manufactured by it will be free from defects in materials and workmanship for the lifetime of the shelving.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. General: Products are based upon Adjustable-Height Wall-Mount Wire Shelving supplied by McMaster-Carr.

2.2 BASIC MATERIALS

- A. General: Provide materials and quality of workmanship, which meet or exceed established industry standards for products specified. Use Stainless Steel, Mil. Spec. MIL-S-40144E, NSF/ANSI Standards. Material thickness/gauges are manufacturer's option unless indicated otherwise.

2.3 MANUFACTURED COMPONENTS

- A. Design:
 - 1. Wall hung type consisting of vertical standards, shelves, and shelf supports, designed to be assembled without fasteners or clips. Shelves shall be wire, vented adjustable type. Shelf fronts and backs shall be flush with outside faces of vertical standards. Design shall permit individual shelf adjustment or removal anywhere along the entire height of the shelving unit. Shelving shall require no tools to erect or make adjustments to, including relocation or removal of individual shelves.
- B. Materials and Workmanship:
 - 1. Fabricate shelf units from 10 guage Stainless Steel, Mil. Spec. MIL-S-40144E, NSF/ANSI Standards. There shall be no sharp edges and shelving shall exhibit no irregular seams, dents or distortion in any manner.
- C. Standards:
 - 1. Formed from 18 guage stainless steel sheet to 1" dia. tubular post 16" high with 1" center-to-center adjustments and 4 mounting brackets.

- D. Shelves:
 - 1. Shelf shall be formed from 10 guage Stainless Steel wire, Mil. Spec. MIL-S-40144E, NSF/ANSI Standards.
- E. Nominal Shelf Dimensions:
 - 1. Width: As indicated on the drawing(s).
 - 2. Depth: As indicated on the drawing(s).
 - 3. Vertical Adjustment increment: 1 inches (25.4 mm)
 - 4. Number of Vertical Shelf Spaces: As indicated on the drawings.
- F. Load Carrying Capabilities:
 - 1. Provide shelf units capable of supporting a minimum of 125 pounds per lineal foot with maximum deflection of L/140. Shelves shall exhibit no permanent deflection under fully loaded conditions.

2.4 FABRICATION

- A. General: Coordinate all parties to ensure timely execution of this project and to related work.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. For stationary shelving installations, with installer present, examine floor surfaces where shelving will be located for compliance with manufacturer's requirements for fixed shelving.
- B. For mobile shelving installations, with installer present, examine mobile carriages for proper sizing, proper placements of support members for the shelving, and to ensure that mounting surface is square and level.
- C. For all installations it shall be the installer's responsibility to know and to execute all phases of the installation in compliance with local building codes.

3.2 INSTALLATION

- A. General: Follow manufacturer's documented instructions and procedures.

3.3 FIELD QUALITY CONTROL

- A. Verify all uprights, shelves, components and accessories are plumb and level. Correct if necessary.

- B. Replace components that are scratched, dented, or damaged in any manner with new items from the manufacturer. Surface scratches may be touched up but repair must be complete and undistinguishable.

3.4 ADJUSTING

- A. Adjust all components and accessories to provide smooth operation and proper alignment.

3.5 CLEANING

- A. Upon completion of installation, clean all components and surfaces. Remove all packaging material, rubbish and debris resulting from installation immediately upon completion of work and leave area(s) of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

- A. Schedule and conduct demonstration of case-type shelf adjustment by manufacturer or dealer authorized representative. Review features and proper operation of accessory items with owner's personnel.
- B. Schedule and conduct maintenance training with owner's maintenance personnel. Training session should include demonstration of shelf adjustment and proper surface cleaning and preservation procedures that end user personnel would normally perform.

3.7 PROTECTION

- A. Protect system against damage during remainder of construction period. Advise owner of additional protection needed to ensure that system will be without damage for remainder of work within the area.

END OF SECTION 105613

SECTION 113200 - UNIT KITCHENS

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 factory-fabricated and -assembled unit kitchens with metal cabinets, countertops, fixtures, appliances, and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and utility connection requirements of appliances.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For unit kitchen cabinet and countertop finishes, door and drawer styles, and appliance finishes.
- D. Samples for Verification: For each type of exposed unit kitchen and appliance finish required, in manufacturer's standard sizes, and including the following:
 - 1. One full-size unit of each type of exposed hardware.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each configuration of unit kitchen and each type of appliance.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each unit kitchen and each appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-assembled units, individually factory packaged and protected. Label with manufacturer's name, product name, and model number.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install unit kitchens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.
- C. Field Measurements: Where cabinets are indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

1.9 COORDINATION

- A. Coordinate layout and installation of blocking and reinforcement in partitions for support of cabinets.
- B. Coordinate wiring requirements and current characteristics of unit kitchens with building electrical system.
- C. Coordinate layout and installation of plumbing, mechanical, and electrical services for unit kitchens.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to provide on-site service for cabinets, counters and appliances as follows:
1. Warranty Type: Full warranty including parts and labor.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: For unit kitchens indicated to be accessible, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC A117.1.

2.2 METAL CABINETS

- A. Choose from the following list:
1. Pro-Fab, Inc.
 2. Patterson Pope
 3. Danver Outdoor Kitchens
- B. Materials:
1. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
- C. Stainless-Steel Base Cabinets: Fabricate frames and sides from 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded and reinforced with internal gussets and bracing.
1. Door and Drawer Fronts: 0.038-inch- (0.95-mm-) thick, stainless-steel sheet; welded, reinforced, and sound deadened.
 - a. Styles and Colors: As selected by Architect from manufacturer's full line.
- D. Toe Kicks: Stainless steel, thickness and finish to match base cabinets, with four adjustable feet.
- E. Legs and Feet: Stainless-steel tubing legs with adjustable bullet feet.
- F. Wall Cabinets: Same material and finish as base cabinets, with flush double bottoms, adjustable shelves, wall hanging bracket, and adjustable front legs.
- G. Shelves: Manufacturer's standard rolled-front shelves, adjustable, of same material and finish as cabinets.
- H. Pulls: Wire type.

1. Metal and Finish: Stainless steel.

- I. 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. Run grain of directional finishes with long dimension of each piece. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1. Bright, Directional Polish: No. 4.

2.3 COUNTERTOPS

- A. Materials:

1. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
2. Stainless Steel: 0.038-inch- (0.95-mm-) thick sheet bonded to 3/4-inch (19-mm) plywood.

- B. Countertop for Drop-in Sink: Seamless, one-piece countertop with integral backsplash.

1. Stainless Steel: 0.038-inch- (0.95-mm-) thick sheet bonded to 3/4-inch (19-mm) plywood.

- C. 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. Run grain of directional finishes with long dimension of each piece. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1. Bright, Directional Polish: No. 4.

2.4 FIXTURES

- A. See Mechanical and Plumbing Drawings for plumbing fixtures and exhaust equipment.

2.5 APPLIANCES

- A. See for Equipment Schedule on the Drawings

2.6 FABRICATION

- A. General: Factory fabricate, finish, and assemble unit kitchens, with base cabinets, appliances, and countertop shipping as a one-piece assembly. Securely fasten components, fixtures, and appliances together.

1. Provide manufacturer's standard hardware including concealed, adjustable plated-steel hinges; steel drawer slides with nylon rollers; and catches and rubber bumpers on doors

and drawers. Unless otherwise indicated, provide chromium-plated metal or satin-finished stainless steel for exposed hardware.

- B. Accessible Units: See Drawings for elevations with dimensions. At a minimum, unit kitchens shall comply with these accessibility regulations as follows:
1. Standard, Accessible Countertops: Fabricate unit kitchens with one-piece countertop located at height of 34 inches (864 mm) above floor.
 2. Knee and Toe Clearance: Provide minimum 30-inch- (760-mm-) wide open space beneath countertop with a minimum clear height of 27 inches (685 mm) above floor for first 8 inches (205 mm) of depth, then reduce clearance at a rate of 1 inch (25 mm) in depth for each 6 inches (150 mm) in height, to a minimum clear height of 9 inches (230 mm) above floor at a depth of 11 inches (280 mm).
 3. Pipe Enclosure Panels: Provide manufacturer's standard panels to enclose plumbing under countertop, of same material and finish as cabinets. Install panel to prevent exposure of sharp or abrasive surfaces under the countertop.
 4. Operable Parts: Locate operable parts no higher than 48 inches (1219 mm) and no lower than 15 inches (380 mm) above floor. Provide operable parts that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Examine walls and partitions for proper backing for unit kitchens.
- D. Examine roughing-in for electrical power mechanical system(s) to verify actual locations of connections before installation of unit kitchens.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims. Provide fasteners, clips, backing materials, brackets, anchors, fillers, scribes, trim, and accessories necessary for complete installation.
 1. Anchor unit kitchens at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent material distortion; use concealed fasteners.

2. Freestanding Ranges: Install antitip anchors at locations recommended by manufacturer.

- B. Comply with requirements specified in Section 221116 "Domestic Water Piping," Section 221123 "Domestic Water Pumps," and Section 221316 "Sanitary Waste and Vent Piping" for connecting unit kitchens to plumbing system(s).
- C. Comply with requirements for connecting unit kitchens to electrical power system.

3.3 ADJUSTING AND CLEANING

- A. Test, adjust, and verify operation of each appliance, plumbing fixture, and component of unit kitchens. Repair or replace items found to be defective or operating below rated capacity.
- B. Verify that operating parts work freely and fit neatly and that clearances are adequate to properly and freely operate appliances.
- C. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- D. After completing unit kitchen installation, remove protective coverings if any.
- E. Repair or replace damaged parts, dents, buckles, abrasions, and other defects affecting appearance or serviceability. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 113200

SECTION 220500 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Plumbing Fixture and piping demolition.
 4. Equipment installation requirements common to equipment sections.
 5. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and toilet rooms fixture.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors
- L. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2" and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT AND FIXTURE INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- A. Install fixtures level and plumb, parallel and perpendicular to other building systems; secured to walls and/or structure.
- B. Install fixtures and service valves to facilitate service, maintenance, and repair or replacement. Connect fixtures for ease of disconnecting, with minimum interference to other installations.
- C. Install fixtures and equipment to allow right of way for piping installed at required slope.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
 - 4. Silicone sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20 psig minimum.
 - 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Non-shrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, non-sag, 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.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Sherwin-Williams Company (The).
 - c. The Dow Chemical Company.
- B. 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. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Sherwin-Williams Company (The).
 - c. The Dow Chemical Company.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in foundation walls, floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves.
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

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SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Keeney Manufacturing Company (The).
 - 3. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.
 - 2. Escutcheons for Existing Piping to Remain:
 - a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: Split floor plate.
 - 2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Pipe-positioning systems.
4. Equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

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HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized, hot dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
2. Indoor Applications: Zinc-coated steel.
3. Outdoor Applications: Stainless steel.

2.4 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- C. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1/2".

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
 - 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 - 6. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 - 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
 - 9. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
 - 10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 10. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- K. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- L. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Seton Identification Products; a Brady Corporation company.
 2. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 3. Letter Color: Black.
 4. Background Color: White.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Marking Services Inc.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Red.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Seton Identification Products.
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or S-hook.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.2 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 10 feet along each run. Reduce intervals to 5 feet in areas of congested piping and equipment.

C. Pipe Label Color Schedule:

1. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety white.
 - b. Letter Color: Black.

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 2. Valve-Tag Colors:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 3. Letter Colors:
 - a. Cold Water: White.
 - b. Hot Water: White.

END OF SECTION 220553

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IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Roof drains and rainwater leaders.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material test reports.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, and hangers specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing and approval of piping systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule."
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - 2. Preformed Pipe Insulation: Type II, Class 1, without jacket.
 - 3. Preformed Pipe Insulation: Type II, Class 2, with factory applied ASJ jacket.
 - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 2. Foster Brand, Specialty Construction Brands, Inc., a business of H. B.
 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
 4. Wet Flash Point: Below 0 deg F.
 5. Service Temperature Range: 40 to 200 deg F.
 6. Color: Black.

2.3 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. McGuire Manufacturing.
 - b. Plumberex Specialty Products, Inc.
 - c. Truebro.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- G. Install insulation with least number of joints practical.
- H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

- I. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- J. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- K. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- L. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD QUALITY CONTROL

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

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

- C. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.
- D. All insulation applications will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.
- B. Domestic Hot Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 3/4 inch thick.

- C. Stormwater:

- 1. All Pipe Sizes: Insulation shall be one of the following:

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PLUMBING PIPING INSULATION

- a. Cellular Glass: 1-1/2 inches thick.
- b. Flexible Elastomeric: 1 inch thick.

D. Roof Drain Bodies:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Piping joining materials.
 - 3. Dielectric fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. WATTS.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. WATTS.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Pipeline Seal and Insulator, Inc.
 2. Nonconducting materials for field assembly of companion flanges.
 3. Pressure Rating: 150 psig.
 4. Gasket: Neoprene or phenolic.
 5. Bolt Sleeves: Phenolic or polyethylene.
 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Precision Plumbing Products.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Victaulic Company.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 1. Hard copper tube, ASTM B88, Type L; copper, solder-joint fittings; and soldered joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

- C. Install valves according to the following:
 - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 - D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
 - E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
 - F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 - G. Install piping above accessible ceilings to allow adequate space for ceiling panel removal, and coordinate with other services occupying that space.
 - H. Install piping to permit valve servicing.
 - I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
 - J. Install piping free of sags and bends.
 - K. Install fittings for changes in direction and branch connections.
 - L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
 - M. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged
 - N. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
 - O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
 - E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
 - F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.
- 3.4 INSTALLATION OF DIELECTRIC FITTINGS
- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- 3.5 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - B. Install hangers for copper piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
 - C. Support horizontal piping within 12 inches of each fitting.
 - D. Support vertical runs of copper piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- 3.6 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
 - C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 5. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 6. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall hydrants.
 - 2. Trap-seal primer device.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 WALL HYDRANTS

A. Nonfreeze Wall Hydrants NFWH:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Exposed with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Nozzle and Wall-Plate Finish: Polished nickel bronze.
9. Operating Keys(s): Two with each wall hydrant.

2.4 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Precision Plumbing Products.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

END OF SECTION 221119

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SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric unions.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less. Confirm gas pressure at site prior to start of work.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. FlashShield Products; Gastite, a division of Titeflex Corp.
 - b. TracPipe CounterStrike; Omega Flex, Inc.
 - c. Tru-Flex Metal Hose Corp.
2. Tubing: ASTM A240/A240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
 - a. 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.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.

6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Corrugated stainless-steel tubing with polymer coating.
3. Operating-Pressure Rating: 0.5 psig.
4. End Fittings: Zinc-coated steel.
5. Threaded Ends: Comply with ASME B1.20.1.
6. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.

6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Flow Controls; Conbraco Industries, Inc.
 - c. BrassCraft Manufacturing Co.; a Masco company.
2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton.
 - b. Maxitrol Company.
 - c. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.7 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. WATTS.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator.
- U. Install pressure gage downstream from each line regulator.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors.
- W. Install sleeve seals for piping penetrations of concrete walls and slabs.
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.3 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameter, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameter, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.

- E. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 CONNECTIONS

- A. Connect to utility's gas main inside building just after meter/regulator according to utility's procedures and requirements. Coordinate and schedule any required gas service shutdowns with owner and utility company.
- B. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.6 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

3.7 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 INDOOR PIPING SCHEDULE

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.9 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves in branch piping for single appliance shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

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FACILITY NATURAL-GAS PIPING

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Copper tube and fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings: ASTM A 74, Service class.
- C. Gaskets: ASTM C 564, rubber.
- D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. Cast-Iron, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. MG Piping Products Company.
 - 2. Standard: ASTM C 1277.
 - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Shielded, Non-pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drainpipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
 - O. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - R. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
 - C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

- a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
- B. Aboveground, vent piping NPS 4 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
- C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
- D. Underground, soil and waste piping NPS 5 and larger shall be the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts: **CO**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor or Yard Cleanouts: FCO / YCO

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts: WCO

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
 - a. Brass.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access, Cover Plate: Round, deep, chrome-plated bronze cover plate with screw.
7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

D. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
 - C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
 - D. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - E. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
 - F. Install vent caps on each vent pipe passing through roof.
 - G. Install wood-blocking reinforcement for wall-mounting-type specialties.
 - H. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains: **FD-1** (Toilet Rooms)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.

14. Top Shape: Round.
15. Dimensions of Top or Strainer: 7" diameter.
16. Top Loading Classification: Medium Duty.
17. Funnel: Not required.
18. Inlet Fitting: Not required.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep-seal P-trap.
21. Trap Features: Trap Guard.

B. Cast-Iron Floor Drains: **FD-2** (Mechanical Areas)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co; a division of Morris Group International.
 - b. Josam Company.
 - c. MIFAB, Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Sanitary drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Not required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Required.
12. Top or Strainer Material: Cast iron.
13. Top of Body and Strainer Finish: Cast iron.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 9" diameter.
16. Top Loading Classification: Heavy Duty.
17. Funnel: Required.
18. Inlet Fitting: Not required.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep-seal P-trap.
21. Trap Features: Trap guard.

2.3 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:

- a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

2.4 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

2.5 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

2.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

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SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Residential, atmospheric, gas-fired, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of residential, gas-fired, domestic-water heater.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Periods: From date of Substantial Completion.
 - a. Residential, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Six years.
 - 2) Controls and Other Components: Two years.
 - 3) year(s).
 - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 RESIDENTIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Residential, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters: **GWH-1**
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. O. Smith Corporation.
 - b. Bradford White Corporation. (Basis of Design)
 - c. State Industries.

2. See domestic water heater schedule on drawing P0.01.
3. Standard: ANSI Z21.10.1/CSA 4.1.
4. Storage-Tank Construction: Steel.
 - a. Tapping's: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tapping's.
5. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Burner: For use with atmospheric, gas-fired, domestic-water heaters and natural-gas fuel.
 - h. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
 - i. Temperature Control: Adjustable thermostat.
 - j. Combination Temperature-and-Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.
6. Draft Hood: Low-profile-type draft diverter, complying with ANSI Z21.12.
7. Automatic Damper: ANSI Z21.66/CSA 6.14, electrically operated, automatic-vent-damper device with size matching draft hood.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AMTROL, Inc. (Basis of Design)
 - b. Flexcon Industries.
 - c. TACO Comfort Solutions, Inc.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
3. Construction:

- a. Tapping's: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
- a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: 2 gal. minimum.
 - c. Max. Acceptance Volume: 0.9 gallon.
 - d. Air Pre-charge Pressure: Static supply pressure.
- B. Mixing Valve:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Powers (Basis of Design)
 - b. Watts
 - c. Honeywell
 2. Capacity and Characteristics:
 - a. ASSE 1070, ASSE 1017 and IAPMO cUPC listed.
 - b. Valve capacity: 13.0 gpm at 45 psi differential.
 - c. Minimum Flow: 0.5 gpm.
 - d. Temperature Control: Adjustable from 80 – 120 deg. F
- C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- D. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- E. Heat-Trap Fittings: ASHRAE 90.2.
- F. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.

- H. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.
 - I. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
 - J. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
 - K. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
 - L. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- 2.4 SOURCE QUALITY CONTROL
- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
 - B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
 - C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Residential, Domestic-Water Heater Mounting: Install residential domestic-water heaters on floor with housekeeping pad.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange unit so controls and devices that require servicing are accessible.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange unit so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heater and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221123 "Facility Natural-Gas Piping."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- G. Fill domestic-water heaters with water.
- H. Charge domestic-water expansion tanks with air to required system pressure.
- I. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- J. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 221123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION 223400

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SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Flushometer valves.
3. Toilet seats.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets, Floor Mounted, Bottom Outlet, Top Spud: **P-1**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn. (Basis of Design - "Meridian" Model 2141-T-3)
 - b. Approved Equal
2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Stainless-Steel.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Standard.

- f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gal. per flush.
 - h. Spud Size and Location: NPS 1-1/2; top.
 - i. Color: Stainless-steel.
3. Bowl-to-Drain Connecting Fitting: ASTM A1045 or ASME A112.4.3.
 4. Flushometer Valve: FV-1.
 5. Toilet Seat: TS-1.

B. Water Closets, Floor Mounted, Bottom Outlet, Top Spud: **P-1A**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn. (Basis of Design - "Meridian" Model R2141-T-3)
 - b. Approved Equal
2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Stainless-Steel.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Handicapped/elderly, complying with ICC/ANSI A117.1.
 - f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gal. per flush.
 - h. Spud Size and Location: NPS 1-1/2; top.
 - i. Color: Stainless-steel.
3. Bowl-to-Drain Connecting Fitting: ASTM A1045 or ASME A112.4.3.
4. Flushometer Valve: FV-1.
5. Toilet Seat: TS-1.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Piston Flushometer Valves: **FV-1**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Sloan. (Basis of Design - "Crown" Model 111)
 - b. Approved Equal
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.

6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 1.28 gal. per flush.
9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats: **TS-1**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn. (Basis of Design -HS-OFLC)
 - b. Approved Equal
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

C. Install toilet seats on water closets.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.3 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall-hung urinals.
2. Flushometer valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals, Back access, back outlet, single: **P-2**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn. (Basis of Design - "Dura-Ware" Model 2158-T-1)
 - b. Approved Equal
2. Fixture:
 - a. Standard: IAPMO PS 61.
 - b. Material: 0.078-inch minimum-thick stainless steel; corrosion-resistant metal for internal piping and bracing.
 - c. Finish: ASTM A480/A480M, No. 4 polished finish on exposed surfaces.
 - d. Type and Configuration: Washout, with top inlet.
 - e. Drain: Strainer with NPS 2 tailpiece and trap.
3. Mounting: Bolts through wall sleeve into accessible service space.

4. Flushometer Valve: FV-2.
5. Wall Sleeve: Galvanized-steel frame of dimensions required to match fixture.

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Piston Flushometer Valves: **FV-2**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Sloan. (Basis of Design - "Crown" Model 186-0.125)
 - b. Approved Equal
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 0.125 gallons per flush.
9. Minimum Inlet: NPS 3/4.
10. Minimum Outlet: NPS 3/4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install wall supports, affixed to building substrate, for wall-hung urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-Steel, wall-mounted lavatories.
2. Supply fittings.
3. Waste fittings.
4. Lavatory supports.

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 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

2.2 STAINLESS-STEEL LAVATORIES

A. Lavatories, wall mounted: **P-3**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn. (Basis of Design - "Dura-Ware" Model 1950-1)
 - b. Approved Equal
2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Material: 0.078-inch minimum-thick stainless steel; corrosion-resistant metal for internal piping and bracing.
 - c. Finish: ASTM A480/A480M, No. 4 polished finish on exposed surfaces.
 - d. Receptor: rectangular bowl with integral soap depression and backsplash.

- e. Drain: Integral punched grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.2/CSA B125.2.
 - f. Height: Standard.
3. Faucet:
- a. Acorn Model -CSG
 - b. Center-set with gooseneck spout with wrist blade handles.
- B. Lavatories, Wall mounted: **P-3A**
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- a. Acorn. (Basis of Design - "Dura-Ware" Model 1950-1)
 - b. Approved Equal
2. Fixture:
- a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Material: 0.078-inch minimum-thick stainless steel; corrosion-resistant metal for internal piping and bracing.
 - c. Finish: ASTM A480/A480M, No. 4 polished finish on exposed surfaces.
 - d. Receptor: rectangular bowl with integral soap depression and backsplash.
 - e. Drain: Integral punched grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.2/CSA B125.2.
 - f. Height: Handicapped/elderly, complying with ICC/ANSI A117.1.
3. Faucet:
- a. Acorn Model -CSG
 - b. Center-set with gooseneck spout with wrist blade handles.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.

- F. Risers:
 - 1. NPS 1/2.
 - 2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2 by NPS 1-1/4.
 - 2. Material:
 - a. Chrome-plated, one-piece, cast-brass trap with swivel 0.029-inch-thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.2 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

3.4 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Countertop sinks.
2. Service Basins,
3. Supply fittings.
4. Waste fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 COUNTERTOP SINK

- A. Countertop Sinks, Stainless steel, counter mounted: **P-5**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Elkay. (Basis of Design - "Lustertone" Model LRADQ252165PD)
- b. Approved Equal

2. Fixture

- a. Standard: ASME A112.19.3/CSA B45.4.
- b. Type: Ledge back.
- c. Number of Compartments: One.
- d. Metal Thickness: 18-gauge stainless steel.

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- e. Number of holes for faucet: 3 with 8-inch centers
 - f. Compartment:
 - 1) Overall Dimensions: 25 inches by 21-1/4 inches by 6-1/2 inch deep.
 - a) Confirm sink size with final cabinetry.
 - 2) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
 - 3) Drain Location: Centered back in compartment.
3. Faucet:
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Elkay. (Basis of Design - Model LKD2439BHC)
 - 2) Approved Equal
 - b. Mounting Type: Deck
 - c. Finish: Chrome
 - d. Handle Type: 4" Lever Handle
 - e. Flow Rate: 1.5 GPM
 - f. Spout Swing Rotation: 360
 - g. Spout Type: Arc Tube
4. Supply Fittings:
- a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Wheel handle.
 - 2) Risers: NPS 1/2 ASME A112.18.6, braided steel flexible hose.
5. Waste Fittings:
- a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2.
 - 2) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
 - c. Continuous Waste:
 - 1) Size: NPS 1-1/2.
 - 2) Material: Chrome-plated, 0.032-inch-thick brass tube.
6. Mounting: On counter with sealant.

2.2 SERVICE BASINS

A. Service Basins (Mop), Stainless Steel, floor mounted: **P-6**

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Metcraft. (Basis of Design - Model 6393-1)

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- b. Approved Equal
2. Fixture:
- a. Standard: IAPMO PS 99.
 - b. Shape: Five sided.
 - c. Nominal Size: 24 by 24 inches.
 - d. Height: 12 inches with dropped front.
 - e. Tiling Flange: Not required.
 - f. Rim Guard: Not required.
 - g. Color: Not applicable.
 - h. Drain: Grid with NPS 3 outlet.
3. Mounting: On floor and flush to wall.
4. Faucet:
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) T&S Brass: (Basis of Design - Model B-0655-BSTP)
 - 2) Approved Equal
 - b. Mounting Type: Wall.
 - c. Finish: Polished chrome.
 - d. Spout: Chrome plated brass spout with vacuum breaker, pail hook and garden hose male outlet.
 - e. Handles: 4" Wrist.
 - f. Support: Lower rod support.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.

- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2.
 - 2. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pressure water coolers and related components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers, wall mounted, wheelchair accessible, bottle filler, vandal resistant: **P-4**
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Elkay. (Basis of Design - Model LZS8WSLP)
 - b. Approved Equal
 - 2. Standards:
 - a. Comply with NSF 61 and NSF 372.
 - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
 - c. Comply with ICC A117.1.
 - 3. Cabinet: Single, all stainless steel.
 - 4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - 5. Control: Push bar.
 - 6. Bottle Filler: Sensor activation with 20-second automatic shutoff timer. Fill rate 0.5 to 1.5 gpm.
 - 7. Drain: Grid with NPS 1-1/4 tailpiece.

8. Supply: NPS 3/8 with shutoff valve.
9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
10. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 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.
12. Capacities and Characteristics:
 - a. Cooled Water: 8 gph.
 - b. Ambient-Air Temperature: 90 deg F.
 - c. Inlet-Water Temperature: 80 deg F.
 - d. Cooled-Water Temperature: 50 deg F.
 - e. Electrical Characteristics:
 - 1) Motor Horsepower: 1/6.
 - 2) Volts: 120-V ac.
 - 3) Phase: Single.
 - 4) Hertz: 60.
 - 5) Full-Load Amperes: 5.
 - 6) Rated Watts: 370.
13. Water Cooler Mounting Height: Handicapped/elderly according to ICC A117.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine wall for suitable conditions where fixture is to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings.
- B. Install mounting frames, affixed to building construction, and attach in-wall, bottle filling stations to mounting frames.

- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices 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 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 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 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 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Composite plastic.

5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. 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.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout (concrete/block walls) or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls Above Grade:
 - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.
 2. Interior Partitions:
 - a. Piping Smaller Than NPS 6: PVC-pipe sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- C. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, and ceilings.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
 - b. Insulated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 230518

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Copper Pipe and Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- B. For Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes and primed and painted.

2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.

- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

J. Insulated Piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use copper-plated pipe hangers and stainless steel attachments for copper piping and tubing.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.

- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 3. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 2. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 3. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 4. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE AND DUCT LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
- D. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 15 feet along each run. Reduce intervals in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Refrigerant Piping: Black letters on a safety-orange background.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 1. Blue: For air supply ducts.
 2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 15 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 ACTION SUBMITTALS

- A. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.4 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine screens and filters. Verify that startup screens and filters have been replaced by permanent screens with indicated perforations.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Duct systems are complete with terminals installed.
 - b. Volume, smoke, and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. Fans are operating, free of vibration, and rotating in correct direction.
 - e. Variable-frequency controllers' startup is complete and safeties are verified.
 - f. Automatic temperature-control systems are operational.
 - g. Ceilings are installed.
 - h. Windows and doors are installed.
 - i. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation,"

Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

- b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses, close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Architect and Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
 - B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
 - C. Adjust air inlets and outlets for each space to indicated airflows.
 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- 3.6 TOLERANCES
- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.7 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Terminal units.
 4. Position of balancing devices.
- E. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- F. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.

- e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- H. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.

- h. Size.
 - i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- I. Instrument Calibration Reports:
1. Report Data:
- a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.8 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect and Owner.
- B. Architect and Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

- F. Prepare test and inspection reports.

3.9 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, [**Type I**] [**Type II with factory-applied vinyl jacket**] [**Type III with factory-applied FSK jacket**] [**Type III with factory-applied FSP jacket**]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation [**without factory-applied jacket**] [**with factory-applied ASJ**] [**with factory-applied FSK jacket**]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.8 SECUREMENTS

- A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.

- B. Insulation Pins and Hangers:
 - 1. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

3. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.9 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.6 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.

3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 1.5-lb/cu. ft. nominal density.
- D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 1. None.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulation for HVAC piping systems.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation" for duct insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material test reports.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
 - 1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
 - 2. Wet Flash Point: Below 0 deg F.
 - 3. Service Temperature Range: 40 to 200 deg F.
 - 4. Color: Black.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
 - 4. Color: White.

2.4 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 - 1. Permanently flexible, elastomeric sealant.
 - a. Service Temperature Range: Minus 100 to plus 300 deg F.
 - b. Color: White or gray.

2.5 SECUREMENTS

- A. Bands:
 - 1. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.
 - 2. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.7 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of welded fittings, two locations of welded strainers, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inch thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2inch thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

END OF SECTION 230719

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.

B. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
 2. Suction Lines for Heat-Pump Applications: 535 psig.
 3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Copper Pressure-Seal Fitting for Refrigerant Piping:
1. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
 2. Housing: Copper.
 3. O-Rings: HNBR or compatible with specific refrigerant.
 4. Tools: Manufacturer's approved special tools.
 5. Minimum Rated Pressure: 700 psig

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 3. Operator: Rising stem and hand wheel.
 4. Seat: Nylon.
 5. End Connections: Socket, union, or flanged.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.

2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and [24] [115] [208]-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with AHRI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

J. Permanent Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.

2. Thermostatic expansion valves.
 3. Hot-gas bypass valves.
 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

- N. Slope refrigerant piping as follows:
1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 2. Install horizontal suction lines with a uniform slope downward to compressor.
 3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

- B. Install the following pipe attachments:
 - 1. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

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SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.

11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. Sealant shall have a VOC content of 420 g/L or less.
11. Sealant shall comply with 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."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Sealant shall have a VOC content of 420 g/L or less.
11. Sealant shall comply with 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."
12. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
13. Service: Indoor or outdoor.
14. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with 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."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
- N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Single Wall:
 - 1. Ductwork shall be Type 304 stainless steel.
 - 2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 3. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 4. Unconditioned Space, Return-Air Ducts: Seal Class B.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
- C. Use duct cleaning methodology as indicated in NADCA ACR.
- D. Use service openings for entry and inspection.
 - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.10 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

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METAL DUCTS

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
 2. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 8.
 2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 3 finish.
 - b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Airtight/watertight.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive or negative 2-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class for Rectangular: 8.

F. Intermediate Reinforcement:

- 1. Galvanized-Steel Ducts: Galvanized steel.
- 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.

G. Elbow Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

H. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Flange connectors.
4. Turning vanes.
5. Duct-mounted access doors.
6. Duct access panel assemblies.
7. Flexible connectors.
8. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.

1.3 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Performance:
 - 1. Maximum Air Velocity: 1000 fpm.
 - 2. Maximum System Pressure: 1 inch wg.
 - 3. AMCA Certification: Test and rate in accordance with AMCA 511.
 - 4. Leakage:
 - a. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
- C. Construction:
 - 1. Frame:
 - a. Hat shaped.
 - b. 16-gauge-thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
 - 2. Blades:
 - a. Multiple single-piece blades.
 - b. Center pivoted, maximum 6-inch width, 16-gauge-thick, galvanized sheet steel with sealed edges.
 - 3. Blade Action: Parallel.
- D. Blade Seals: Extruded vinyl, mechanically locked.
- E. Blade Axles:
 - 1. Material: Nonferrous metal.
 - 2. Diameter: 0.20 inch.
- F. Tie Bars and Brackets: Aluminum.
- G. Return Spring: Adjustable tension.

- H. Bearings: Brass sleeve.
- I. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Chain pulls.
 - 4. Screen Mounting:
 - a. Front mounted in sleeve.
 - 1) Sleeve Thickness: 20 gauge minimum.
 - 2) Sleeve Length: 6 inches minimum.
 - 5. Screen Material: Galvanized steel.
 - 6. Screen Type: Bird and Insect.
 - 7. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
 - 2. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 - 3. Frames:
 - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; 16 gauge thick.
 - 5. Blade Axles: Nonferrous metal.
 - 6. Bearings:
 - a. Oil-impregnated bronze.

1. Single wall.

2.6 FLEXIBLE CONNECTORS

- A. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

2.7 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.8 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 1. Galvanized Coating Designation: G90.
 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-ft. spacing.
 - 8. Upstream from turning vanes.
 - 9. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:

1. Two-Hand Access: 12 by 6 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that size and location of access doors are adequate to perform required operation.
3. Inspect turning vanes for proper and secure installation and verify that vanes do not move or rattle.

END OF SECTION 233300

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SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed face grilles.
2. Door louvers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GRILLES

A. Fixed Face Grille:

1. Material: Steel and Aluminum as indicated by Schedule and Model Number.
2. Finish: Baked enamel, color selected by Architect.
3. Face Blade Arrangement: Horizontal; spaced 3/4 inch apart.
4. Face Arrangement: Perforated core.
5. Core Construction: Integral or Removable.
6. Frame: 1-1/4 inches wide, minimum 20-gauge.
7. Mounting: Countersunk screw.
8. Accessory: Filter.

2.2 DOOR GRILLES AND LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles. Louver shall be minimum 50 percent free area.

1. Blade/Louver: 16-gauge, Galvanneal sheet.
2. Frames: 1-1/4-inch trim, mitered and welded corners, Galvanneal sheet. Minimum 0.032-inch- (0.8-mm-) thick steel frame.

3. Sight-proof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades with 1-inch blade spacing.
4. Screen: Mesh insect and bird screen installed in roll-formed frame to corridor side of door.
5. Finish: Paint to match door color and material. Architect to review and select color.
6. Basis of Design: Activar Construction Products Group, Inc.; Lancaster, PA or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 233813 - KITCHEN HOODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Kitchen hoods.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Kitchen hoods.

B. Shop Drawings:

1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
2. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
3. Include diagrams for power, signal, and control wiring.
4. Duct Connections: Detail connections between ducts and hoods, including access doors and panels.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide kitchen hood as scheduled on the drawings.

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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Coordinate equipment layout and installation with adjacent Work, including luminaires, HVAC equipment, plumbing, and fire-suppression system components.

- B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, and grease extractor according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- C. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.
- D. Install hoods to operate free from vibration.
- E. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- F. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- G. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- H. Set field-adjustable switches.
- I. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Kitchen hoods will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 233813

SECTION 235123 - GAS VENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Listed double-wall vents.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For vents.
 - 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. Detail fabrication and assembly of hangers and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

- A. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

- B. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.
- C. Inner Shell: ASTM B209, Type 3105 aluminum.
- D. Outer Jacket: Galvanized steel.
- E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Listed Type B and BW Vents: Vents for certified gas appliances.

3.2 INSTALLATION OF LISTED VENTS

- A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Lap joints in direction of flow.
- E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

SECTION 237223.19 – PACKAGED INDOOR FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed-plate, total heat exchangers in packaged, indoor, energy-recovery units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For packaged, indoor, fixed-plate, energy-recovery units.

1. Include plans, elevations, sections, details, and mounting 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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, elevations, and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate sizes and locations of access panels with actual equipment provided and location of installation.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, indoor, fixed-plate, energy-recovery units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy-Recovery Unit Parts: Five years.
2. Warranty Period for Fixed-Plate Total Heat Exchanger Core: 15 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Energy recovery component certified in accordance with ARU Standard 1060-2000.
- B. UL Compliance:
 1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.

2.2 PACKAGED, INDOOR, FIXED-PLATE TOTAL ENERGY RECOVERY UNITS

- A. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed, hinged access doors or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch-thick thermal insulation, knockouts for electrical connections, exterior drain connection, and lifting lugs.
- C. Fixed-Plate Total Heat Exchanger:
 1. Casing: Galvanized steel.
 2. Plates: Evenly spaced and sealed and arranged for cross-flow.
 - a. Plate Material: Chemically treated polypropylene core (UL94V2 Rated) with selective hydroscopicity and moisture permeability, and gas barrier properties.
- D. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators of 1-inch static deflection.
 1. Motor and Drive: Direct driven.
 2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- E. Filters:
 1. Description: Flat, nonpleated factory-fabricated, self-supported, disposable air filters with holding frames.
 2. UL Compliance: Comply with UL 900.
 3. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.

4. Filter Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.
 5. Filter Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
- F. Frost Protection:
1. Factory-controlled, timed circulation cycle when outside air temperature is below 23 Deg F.
- G. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.
1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
 2. Include fused disconnect switches.

2.3 CONTROLS

- A. Control Panel: Solid-state, programmable, microprocessor-based control unit for wall mounting.
- B. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
- C. Frost Control: Timed circulation based on temperature.
- D. Enthalpy sensor.
- E. Dirty filter switch.
- F. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.

2.4 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060.
- C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.
- D. Fan Sound Ratings: Comply with ISO 5136 Standard for measurement.
- E. UL Compliance:

1. Packaged fixed plate energy recovery units shall comply with requirements in UL 1812; or UL 1815.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine casing insulation materials and filter media before packaged, indoor, fixed-plate, energy-recovery unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- B. Install packaged, indoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.
 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
 3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- C. Suspended Units: Suspend units from structural-steel support frame, using threaded steel rods and spring hangers.
- D. Install units with clearances for service and maintenance.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

3.2 DUCTWORK CONNECTIONS

- A. Comply with requirements for ductwork according to Section 233113 "Metal Ducts."
- B. Connect duct to units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished with units but not factory mounted.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

- E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Packaged, indoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION 237223.19

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SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning units consisting of separate evaporator-fan/gas-furnace components and compressor-condenser components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- 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. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. Furnace Heat Exchanger: 10 years.
 - c. Integrated Ignition and Blower Control Circuit Board: Five years.
 - d. For Parts: One year(s) from date of Substantial Completion.
 - e. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.
- B. General Requirements for Noncondensing Gas-Fired Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.

2.2 GAS-FIRED FURNACES, NONCONDENSING

- A. Cabinet: Galvanized steel.
 - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
 - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
 - 3. Factory paint external cabinets in manufacturer's standard color.
 - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Type of Gas: Natural.
- C. Heat Exchanger: Stainless steel.
- D. Burner:
 - 1. Gas Valve: 100 percent safety modulating main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
 - 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- E. Gas-Burner Safety Controls:

1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- F. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; and adjustable fan-on and fan-off timing; terminals for connection to accessories.
- 2.3 Vent Materials: Comply with requirements in Section 235123 "Gas Vents" for Type B metal vents.
- 2.4 INDOOR UNITS (5 TONS OR LESS)
- A. Concealed Evaporator-Fan Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 2. Insulation: Faced, glass-fiber duct liner.
 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins. For integration with Variable-Refrigerant Flow Systems see Section 238129 "Variable-Refrigerant Flow HVAC Systems" for expansion valve kits designed to integrate non-VRF equipment with VRF equipment refrigerant circuits. Comply with ARI 206/110.
 4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
 5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.

- 2) Thickness: 1 inch.
 - 3) MERV according to ASHRAE 52.2: 6.
 - 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- c. Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
8. Condensate Drain Pans:
- a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 2 inches deep.
 - b. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
 - 1) Minimum Connection Size: NPS 3/4.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

2.5 OUTDOOR UNITS (5 TONS OR LESS)

- A. Refer to Section 238129 “Variable-Refrigerant Flow HVAC Systems” for outdoor, air-source, heat pump units for use with this equipment.

2.6 ACCESSORIES

- A. Thermostat: Refer to Section 238129 “Variable-Refrigerant Flow HVAC Systems” for controls related to operation of this equipment.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- C. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Install units level and plumb.
- C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- D. Install and connect refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Refrigerant Coil Connections: Comply with requirements specified in Section 232300 "Refrigerant Piping." Connect refrigerant piping to coil connections.
 - 2. Gas piping installation requirements are specified in Section 231123 "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
 - 3. Vent Connection, Noncondensing, Gas-Fired Furnaces: Connect Type B vents to furnace vent connection and extend outdoors. Type B vents and their installation requirements are specified in Section 235123 "Gas Vents."
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

- 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."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

- 3.5 Install control and electrical power wiring to field-mounted control devices.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes complete VRF HVAC system(s) including, but not limited to, delegated design and the following components to make a complete operating system(s) according to requirements indicated:
1. Indoor, recessed, ceiling-mounted units.
 2. Outdoor, air-source, heat pump units.
 3. System controls.
 4. System refrigerant and oil.
 5. System condensate drain piping.
 6. Unit security cages.
 7. Equipment stands.
 8. Miscellaneous support materials.
 9. Piping and tubing insulation.
 10. System control cable and raceways.

1.2 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- E. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.
- F. VRF: Variable refrigerant flow.

1.3 ACTION SUBMITTALS

- A. Product data.
- B. Shop Drawings: For VRF HVAC systems.
 - 1. Include plans, elevations, sections, and mounting 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittals:
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
 - 3. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
 - 4. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, using input from installers of the items involved.
- B. Qualification Data:
 - 1. For Installer.
 - 2. For VRF HVAC system manufacturer.
 - 3. For VRF HVAC system provider.
- C. Product Certificates: For each type of product.
- D. Product test reports.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample warranties.

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 CD or DVD, USB media, or approved cloud storage platform, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

- A. Factory-Authorized Service Representative Qualifications:
 - 1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
 - 2. In-place facility located within twenty miles of Project.
 - 3. Demonstrated past experience with products being installed for period within five consecutive years before time of bid.
 - 4. Demonstrated past experience on five projects of similar complexity, scope, and value.
 - a. Each person assigned to Project shall have demonstrated past experience.
 - 5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
 - 6. Service and maintenance staff assigned to support Project during warranty period.
 - 7. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.
 - 8. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.
 - 1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
 - 2. Installer certification shall be valid and current for duration of Project.
 - 3. Retain copies of Installer certificates on-site and make available on request.
 - 4. Each person assigned to Project shall have demonstrated past experience.
 - a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
 - b. Demonstrated past experience on three projects of similar complexity, scope, and value.
- C. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: 10 year(s) from date of Substantial Completion.
 - b. For Parts, Including Controls: Five year(s) from date of Substantial Completion.
 - c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Daikin AC (Americas), Inc.
 - 2. LG Electronics [Basis of Design].
 - 3. Mitsubishi Electric & Electronics USA, Inc.
 - 4. Samsung HVAC.

2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
 - 1. Two-pipe system design.
 - 2. System(s) operation, air-conditioning and/or heat pump as indicated on Drawings.
 - 3. Each system with one refrigerant circuit shared by all indoor units connected to system. Refer to drawings for system configuration and number of units.
- 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. AHRI Compliance: System and equipment performance certified according to AHRI 1230.
- D. ASHRAE Compliance:
 - 1. ASHRAE 15: For safety code for mechanical refrigeration.
 - 2. ASHRAE 62.1: For indoor air quality.
 - 3. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional specialist, as defined in Section 014000 "Quality Requirements," to design complete and operational VRF HVAC system(s) complying with requirements indicated.
1. Provide system refrigerant calculations.
 - a. Refrigerant concentration limits shall be within allowable limits of ASHRAE 15 and governing codes.
 - b. Indicate compliance with manufacturer's maximum vertical and horizontal travel distances. Prepare a comparison table for each system showing calculated distances compared to manufacturer's maximum allowed distances.
 2. Include a mechanical ventilation system and gas detection system as required to comply with ASHRAE 15 and governing codes.
 3. System Refrigerant Piping and Tubing:
 - a. Arrangement: Arrange piping to interconnect indoor units and outdoor unit(s) in compliance with manufacturer requirements and requirements indicated.
 - b. Routing: Conceal piping above ceilings and behind walls to maximum extent possible.
 - c. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.
 4. System Controls:
 - a. Network arrangement.
 - b. Network interface with other building systems.
 - c. Product selection.
 - d. Sizing.
- B. Service Access:
1. Provide and document service access requirements.
 2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
 3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
 4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
 5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
 6. Comply with OSHA regulations.
- C. System Design and Installation Requirements:

1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
 2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- D. Isolation of Equipment: Provide isolation valves to isolate each indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- E. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
1. Range acceptable to manufacturer.
- F. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.
- G. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.
- H. Outdoor Conditions:
1. Suitable for outdoor ambient conditions encountered.
 - a. Design equipment and supports to withstand wind loads of governing code.
 - b. Design equipment and supports to withstand snow and ice loads of governing code.
 - c. Provide corrosion-resistant coating for components and supports.
 2. Maximum System Operating Outdoor Temperature: See Drawings.
 3. Minimum System Operating Outdoor Temperature: See Drawings.
- I. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.
1. Indoor: Within design guidelines of "2015 ASHRAE HANDBOOK- HVAC Applications."
 2. Outdoor: Within ordinance of governing authorities.
- J. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.
- K. Capacities and Characteristics: As indicated on Drawings.
- 2.4 INDOOR, RECESSED, CEILING-MOUNTED UNITS
- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
- B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):
 - a. Direct-drive arrangement.
 - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
 - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
 - d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Efficiency: ASHRAE 52.2, MERV 7.
3. Media: If more than one filter type is indicated, Contractor has option to choose.

- a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
 - b. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.
1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.
 - a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.
 - b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.
- H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.
- I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.
- J. Unit Accessories:
1. Outdoor Air Ventilation Kit: Connection, motorized damper, and control to satisfy unit control sequence of operation indicated on Drawings.
 2. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
- K. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 2. Factory-Installed Controller: Configurable digital control.
 3. Factory-Installed Sensors: Unit inlet air temperature, Coil entering refrigerant temperature, Coil leaving refrigerant temperature.
 4. Field-Customizable I/O Capability:
 - a. Analog Inputs: Two for use in customizable control strategies.
 - b. Digital Inputs: Two for use in customizable control strategies.
 - c. Digital Outputs: Two for use in customizable control strategies.
 5. Features and Functions: Self-diagnostics, time delay, auto-restart, external static pressure control, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.
 6. Communication: Network communication with other indoor units and outdoor unit(s).
 7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- L. Unit Electrical:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
 2. Field Connection: Single point connection to power entire unit and integral controls.

3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.5 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
 1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
 2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
 3. All units installed shall be from the same product development generation.
- B. Cabinet:
 1. Galvanized steel and coated with a corrosion-resistant finish.
 - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
 2. Mounting: Manufacturer-designed provisions for field installation.
 3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
 1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
 2. Protection: Integral protection against the following:
 - a. High refrigerant pressure.
 - b. Low oil level.
 - c. High oil temperature.
 - d. Thermal and overload.
 - e. Voltage fluctuations.
 - f. Phase failure and phase reversal.
 - g. Short cycling.
 3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
 4. Vibration Control: Integral isolation to dampen vibration transmission.
 5. Oil management system to ensure safe and proper lubrication over entire operating range.
 6. Crankcase heaters with integral control to maintain safe operating temperature.

7. Fusible plug.
- D. Condenser Coil Assembly:
1. Plate Fin Coils:
 - a. Casing: Aluminum, galvanized, or stainless steel.
 - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
 - c. Tubes: Copper, of diameter and thickness required by performance.
 2. Aluminum Microchannel Coils:
 - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
 - b. Single- or multiple-pass arrangement.
 - c. Construct fins, tubes, and header manifolds of aluminum alloy.
 3. Coating: Corrosion resistant.
 4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
1. Fan(s): Propeller type.
 - a. Direct-drive arrangement.
 - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
 - c. Statically and dynamically balanced.
 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
 5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
 6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
 2. Factory-Installed Controller: Configurable digital control.
 3. Factory-Installed Sensors:
 - a. Refrigerant suction temperature.
 - b. Refrigerant discharge temperature.

- c. Outdoor air temperature.
 - d. Refrigerant high pressure.
 - e. Refrigerant low pressure.
 - f. Oil level.
4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch.
 5. Communication: Network communication with indoor units and other outdoor unit(s).
 6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
 2. Field Connection: Single point connection to power entire unit and integral controls.
 3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
 4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
 5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
 6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
 2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
 3. Field Piping Connections: Manufacturer's standard.
 4. Factory Charge: Dehydrated air or nitrogen.
 5. Testing: Factory pressure tested and verified to be without leaks.
- K. Unit Security Frame
1. Frame: 1.5-inch x 1.5-inch x 1/8-inch steel angle iron with base flange 1.5-inch with 1/2-inch anchor hole on four sides. Construction shall be through MIG welding.
 2. Reinforcement Bands: Center and Top: 1.5-inch x 1/8-inch steel flat bar.
 3. Expanded Metal: 3/5 #13 flat
 4. Finish: Powder-coated satin black
 5. Lid: Lock housing 4-inch round x 1/4-inch thick.. Designed to accept a standard puck lock. Provide hinge pins of 1/2-inch round stock with 1/2" round barrels. Provide lock and four sets of keys to Owner.

6. Mounting: Mount frame to wall of building, around HVAC unit and HVAC support frame. Secure to building with tamper proof mounting hardware encapsulated by Unit Security Frame to prevent access.

2.6 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
3. Operator Interface:
 - a. Operators shall interface with system and unit controls through the following:
 - 1) Operator interfaces integral to controllers.
 - 2) Owner-furnished PC connected to central controller(s).
 - 3) Web interface through web browser software.
 - b. Users shall be capable of interface with controllers for control of indoor units to extent privileges are enabled. Control features available to users shall include the following:
 - 1) On/off control.
 - 2) Temperature set-point adjustment.

B. VRF HVAC System Operator Software for PC:

1. Software offered by VRF HVAC system manufacturer shall provide system operators with ability to monitor and control VRF HVAC system(s) from a single dedicated Owner-furnished PC.
2. Software shall provide operator with a graphic user interface to allow monitoring and control of multiple central controllers from a single device location through point-and-click mouse exchange.
3. Plan views shall show building plans with location of indoor units and identification superimposed on plans.
4. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
5. Schedules operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Schedules daily, weekly, and annual events.
6. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
7. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
8. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
9. Supports Multiple Languages: English or Spanish.
10. Supports Imperial Temperature Units: Fahrenheit.

11. Displays service notifications and error codes.
12. Monitors and displays up to 3000 item error history and 10000 item operation history for regular reporting and further archiving.
13. Monitors and displays cumulative operating time of indoor units.
14. Able to disable and enable operation of individual controllers for indoor units.
15. Information displayed on individual controllers shall also be available for display.
16. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.

C. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
 - a. Include multiple interconnected controllers as required.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
 - a. Sets schedule for daily, weekly, and annual events.
 - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.
9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel and web accessible through standard web browser software.

2.7 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A1 refrigerant classification.
3. R-410a.

- B. Oil:
 - 1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.8 SYSTEM CONDENSATE DRAIN PIPING

- A. CPVC plastic pipe according to ASTM F441/F441M, Schedule 40, with socket-type pipe fittings according to ASTM F438 and solvent cement according to ASTM F493.

2.9 SYSTEM REFRIGERANT PIPING

- A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.
- B. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- C. Refrigerant Isolation Ball Valves:
 - 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
 - 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
 - 3. Valve Connections: Flare or sweat depending on size.

2.10 OUTDOOR EQUIPMENT STANDS

- A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.
- B. Foot Material: Rubber or polypropylene.
- C. Rails Material: Hot-dip galvanized carbon steel.
- D. Wind/Sliding Load Resistance: Up to 100 mph minimum.

2.11 MISCELLANEOUS SUPPORT MATERIALS

- A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- B. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

2.12 PIPING AND TUBING INSULATION

- A. Comply with requirements in Section 230719 "HVAC Piping Insulation" for system piping insulation requirements.

2.13 SYSTEM CONTROL CABLE AND RACEWAYS

- A. Low-Voltage Control Cabling:
 - 1. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
- B. TIA-485A Network Cabling:
 - 1. Standard Cable: NFPA 70, Type CMG.
 - 2. Plenum-Rated Cable: NFPA 70, Type CMP.
- C. Ethernet Network Cabling: TIA-568-C.2 Category 6 cable with RJ-45 connectors.
- D. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for control wiring and cable raceways.

2.14 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.
 - 1. Standards:
 - a. ASTM B117 for salt spray.
 - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
 - c. ASTM B3359 for cross-hatch adhesion of 5B.
 - 2. Application: Spray.
 - 3. Thickness: 1 mil.
 - 4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.15 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Clearance:
 - 1. Maintain manufacturer's recommended clearances for service and maintenance.
 - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
 - 1. Loose components shall be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.
- C. Equipment Restraint Installation: Install equipment with seismic-restraint device. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- D. Indoor Unit Installations:
 - 1. Install units to be level and plumb while providing a neat and finished appearance.
 - 2. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.
 - 3. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
 - 4. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
 - 5. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
 - 6. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
 - 7. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
 - 8. Floor-mounted units located in mechanical rooms.
 - 9. Install floor-mounted units on support structure indicated on Drawings.
 - 10. Install floor-mounted units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 11. Attachment: Install hardware for proper attachment to supported equipment.
 - 12. Grouting: Place grout under equipment supports and make bearing surface smooth.

- E. Outdoor Unit Installations:
 - 1. Install units to be level and plumb while providing a neat and finished appearance.
 - 2. Install outdoor units on support structures indicated on Drawings.

3.2 GENERAL REQUIREMENTS FOR PIPING AND TUBING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 CONDENSATE DRAIN PIPE AND TUBING INSTALLATION

- A. General Requirements for Drain Piping and Tubing:
 - 1. Install a union in piping at each threaded unit connection.
 - 2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.

3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
 - a. Details indicated on Drawings.
 - b. Manufacturer's requirements.
 - c. Governing codes.
 - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of not less than two percent.

C. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

3.4 REFRIGERANT PIPING AND TUBING INSTALLATION

A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
2. Support tubing using hangers and supports indicated at intervals not to exceed [**5 feet**] <Insert dimension>. Minimum rod size, 1/4 inch.
3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

B. Install refrigerant piping according to ASHRAE 15 and governing codes.

C. Select system components with pressure rating equal to or greater than system operating pressure.

D. Install piping as short and direct as possible, with a minimum number of joints and fittings.

E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
 - 1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Joint Construction:
 - 1. Ream ends of tubes and remove burrs.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
 - 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
 - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
 - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.5 PIPE AND TUBING INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.
- B. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 DUCT, ACCESSORIES, AND AIR OUTLETS INSTALLATION

- A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
- B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
- C. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
- D. Comply with requirements for registers and grilles specified in Section 233713.23 "Registers and Grilles."

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of manufacturer's service representative:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Refrigerant Tubing Positive Pressure Testing:
 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
 2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.

- g. Name of person ending test, company name, phone number, and e-mail address.
- h. Date and time at end of test.
- i. Test pressure at end of test.
- j. Outdoor temperature at end of test.
- k. Remarks:

- 5. Submit test reports for Project record.

C. Refrigerant Tubing Evacuation Testing:

- 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
- 2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
- 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
- 4. Prepare test report to record the following information for each test:
 - a. Name of person starting test, company name, phone number, and e-mail address.
 - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
 - c. Detailed description of extent of tubing tested.
 - d. Date and time at start of test.
 - e. Test pressure at start of test.
 - f. Outdoor temperature at start of test.
 - g. Name of person ending test, company name, phone number, and e-mail address.
 - h. Date and time at end of test.
 - i. Test pressure at end of test.
 - j. Outdoor temperature at end of test.
 - k. Remarks:
- 5. Submit test reports for Project record.
- 6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

D. System Refrigerant Charge:

- 1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
- 2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
- 3. System refrigerant charging shall be witnessed by system manufacturer's representative.
- 4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

E. Products will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.
 - 1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
 - 2. Complete startup service of each separate system.
 - 3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:
 - 1. Check control communications of equipment and each operating component in system(s).
 - 2. Check each indoor unit's response to demand for cooling and heating.
 - 3. Check each indoor unit's response to changes in airflow settings.
 - 4. Check each indoor unit and outdoor unit for proper condensate removal.
 - 5. Check sound levels of each indoor and outdoor unit.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
 - 1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
 - 1. After completion of startup service, manufacturer shall issue a report for each separate system.
 - 2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
 - 3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.
 - a. All available system operating parameters shall be included in the information submitted.
- E. Witness:
 - 1. Invite Architect Owner and Commissioning Agent to witness startup service procedures.
 - 2. Provide written notice not less than 15 business days before start of startup service.

3.9 ADJUSTING

- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.

- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.
- D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one 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.

3.11 DEMONSTRATION

- A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

END OF SECTION 238129

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SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and 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 details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- 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 CABINET

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.3 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.4 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.5 CONTROLS

- A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated, drawn copper current-carrying conductor with an overall insulation layer, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Technologies Corporation.
2. Phelps Dodge.
3. Southwire Company.
4. Triangle.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Electrical Products.
 - 2. Burndy; a part of the Hubbell family.
 - 3. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 4. Thomas & Betts Corporation; A Member of the ABB Group.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 8 AWG and smaller; stranded for No. 6 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 8 AWG and smaller; stranded for No. 6 AWG and larger.
- C. Minimum Size: No. 14 for control wiring and No. 12 for all other unless otherwise noted.

3.2 CONDUCTOR INSULATION CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- E. Provide one neutral conductor for each single phase, 3 wire homerun to each panelboard. Shared neutrals are not acceptable.
- F. Use No. 10 AWG for all 120 V circuits that exceed 75 feet.
- G. Use No. 10 AWG for all emergency lighting circuits.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. All splicing shall be done in outlet, panel and junction boxes, and not in conduits or equipment cabinets. Splices or taps in conductors shall be made with connectors and wrapped with rubber tape of a type and thickness equivalent to the original insulation and then covered with friction tape. When connecting stranded cables together, each strand shall be carefully cleaned before soldering or connecting. All taps and splices in branch circuit wiring shall be made with pressure type connectors.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- E. Conductors No. 10 AWG and Smaller: Twist-on solderless pressure connector, spiral metal spring in metal cup or crimped metal sleeve, plastic insulating cap with long flared skirt to cover un-insulated portion of conductor.
- F. Conductors No. 8 AWG and Larger: Copper alloy.
 - 1. Wire Connector: Long barrel compression type attached with hydraulic die.
 - 2. Bus Connector: Compression type with multiple bolts, tin plated flat washer.
 - 3. Applied Insulation: Vinyl tape over insulating filler, heat shrinkable sleeves, or pre-molded plastic enclosure to fit each specific combination of connector and conductors.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO; a brand of nVent.
 - 3. Harger Lightning & Grounding.
 - 4. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 5. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction. Conductors to have green insulation.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- G. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- H. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- I. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below final grade unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. Use exothermic welds for all below-grade connections.
 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
- D. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each ground rod and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Mounting, anchoring, and attachment components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 9/16-inch x 1-1/8-inch slots spaced at a minimum of 2-inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. B-line, an Eaton business.
 - b. Flex-Strut Inc.
 - c. G-Strut.
 - d. Thomas & Betts Corporation; A Member of the ABB Group.
 - e. Unistrut; Part of Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel: Plain steel.
4. Finish for Channel: Hot-dipped galvanized after fabrication according to ASTM A123.
5. Material Thickness: 12-gauge.
6. Channel Dimensions: 1-5/8 inches by 1-5/8 inches.
7. Material for Channel Nuts, Fittings, Clamps, and Hardware: Steel.
8. Finish for Channel Nuts, Fittings, Clamps, and Hardware: Electro-plated zinc.

B. Conduit Support Devices: Zinc-plated steel hangers, clamps, and associated fittings, designed for types and sizes of raceway to be supported.

- A. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Clamps for Attachment to Steel Structural Elements: Electro-galvanized steel. MSS SP-58 units are suitable for attached structural element.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, 316 stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 3. Concrete Screw Anchors: 410 stainless steel; Tapcon or approved equal.
 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 5. Toggle Bolts: All-steel springhead type.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
 2. NECA 101
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- A. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Masonry: Approved toggle-type bolts on hollow masonry units and concrete screw anchors on solid masonry units.
 2. To Existing Concrete: Concrete screw or mechanical-expansion anchors.
 3. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 4. To Light Steel: Sheet metal screws.
 5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount equipment and other devices on slotted-channel racks attached to substrate.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Surface raceways.
3. Boxes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Republic Conduit.
 - d. Western Tube and Conduit Corporation.
 - e. Wheatland Tube Company.
2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; zinc-coated steel.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Republic Conduit.
 - d. Western Tube and Conduit Corporation.
 - e. Wheatland Tube Company.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 4. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
- C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in gray. Provide all fittings, faceplates, bases, covers, and miscellaneous components for a complete system.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Wiremold / Legrand; Single channel – 3000 Series and Dual channel – 4000 series or a comparable product by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. MonoSystems, Inc.
 - c. Panduit Corp.

2.3 BOXES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EGS/Appleton Electric.
 2. Hoffman; a brand of nVent.
 3. Hubbell Incorporated.
 4. Hubbell Incorporated; Wiring Device-Kellems.
 5. Oldcastle Enclosure Solutions.
 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
 7. Spring City Electrical Manufacturing Company.
 8. Thomas & Betts Corporation; A Member of the ABB Group.

- B. General Requirements for Boxes: Boxes installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb. shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Underground Conduit: GRC.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
 - 1. Exposed: EMT.
 - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Damp or Wet Locations: GRC.
 - 5. Boxes: NEMA 250, Type 1.
 - 6. EMT for fire alarm cabling shall be red in color. Coating(s) shall be factory applied.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.
- C. Do not fasten conduits onto the bottom side of a metal deck roof.
- D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- E. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- L. Surface Raceways:
 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section.

Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- M. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 18 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- N. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- P. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Q. A separation of not less than 6 in. shall be maintained between all conduits and hot water or steam lines in the building, whenever possible. When it is not possible to provide the 6 in. separation an insulating pipe covering shall be installed on the electrical conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom.
 - 2. Install backfill.
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
 - 4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Equipment labels.
 - 2. Tapes.
 - 3. Cable ties.
 - 4. Fasteners for labels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.

2.2 EQUIPMENT LABELS

- A. Laminated Acrylic or Melamine Plastic Labels:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.
 - 2. Engraved legend.
 - 3. White letters on a black field.

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IDENTIFICATION FOR ELECTRICAL SYSTEMS

4. Thickness: 1/16 inch thick, minimum.
5. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.

2.3 TAPES

A. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Ideal Industries, Inc.
 - d. Marking Services, Inc.
 - e. Seton Identification Products; a Brady Corporation company.
2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
4. Tape:
 - a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 8 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 34 lb/1000 sq. ft..
 - f. Tensile according to ASTM D882: 300 lbf and 12,500 psi.

2.4 CABLE TIES

- ### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
 2. Ideal Industries, Inc.
 3. Marking Services, Inc.
 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg. F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg. F.
 4. Color: Black, except where used for color-coding.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg. F according to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg. F.
 5. Color: Black.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Nameplates and Labels: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Coordinate identification with Project Drawings.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Underground Line Warning Tape: Install tape 12 inches above buried raceway.
- E. Laminated Acrylic or Melamine Plastic Equipment Labels:
1. Attach equipment labels with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- F. Cable Ties: General purpose, for attaching tags, except as listed below:

1. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- B. Equipment Identification Labels:

1. Equipment to Be Labeled:

- a. Panelboards:

- 1) Line 1: "Panelboard designation".
- 2) Line 2: "Panelboard voltage, phase, wire".
- 3) Line 3: "Panelboard fed from – include source designation and circuit breaker number".

- b. Disconnect Switches:

- 1) Line 1: "Switch (mechanical equipment) designation".
- 2) Line 2: "Switch fed from – include source designation and circuit breaker number".

- c. Room Controllers:

- 1) Line 1: "Room(s) controlled by".
- 2) Line 2: "Controller fed from – include source designation and circuit breaker number".

- d. Time Clock:

- 1) Line 1: "Lights(s) controlled by".
- 2) Line 2: "Time Clock fed from – include source designation and circuit breaker number".

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Outdoor photoelectric switches.
3. Passive infrared ceiling sensors.
4. Ultrasonic ceiling sensors.
5. Room controllers.
6. Low-voltage digital switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME (CLOCK) SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Contact Configuration: SPDT; 2 channels.
3. Contact Rating: 30A ballast load, 120VAC; 30A General Purpose, 24-277VAC.
4. Scheduling: 99 ON and OFF set points to allow individual program for each day of the week at a minimum of 1 minute apart.
5. Astronomic: Adjusts daily to changes in sunset times. Adjustable 10–60 degrees Northern or Southern latitudes can be individually offset ± 1 to 240 minutes from both sunset and sunrise times.
6. Seasons: 1 to 4 different daily schedules which can wrap around into the new year.
7. Holidays: 1 to 24 individual dates.
8. Signal/Pulse Duration: 2 different settings per channel; 1-99 seconds.
9. Daylight Saving: Automatic adjustment.
10. Leap Year: Automatic compensation.
11. Manual Override: Until the next regularly scheduled ON or OFF, automatic operation then resumes. In signal mode, activates pulse.
12. Clock Format: AM/PM or 24-Hour Format.
13. Power Outage Backup: Supercapacitor provides 7 days of real time backup.
14. Enclosure: NEMA 3R, plastic.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

- A. Description: Solid state, with SPST dry contacts rated for 1800 VA ballast, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor: Conformal coated cadmium sulphide photocell. Photocell responds to the light spectrum near to that of a human eye.
3. Time Delay: Delay up to two minutes to prevent false switching due to light from passing vehicles, lighting, etc.
4. Housing: Impact and vandal resistant Lexan. Translucent dome shall prolong cell life by screening out ultraviolet rays. Dome and base shall be ultrasonically welded for maximum strength.
5. Light-Level Monitoring Range: Turn ON is 1 to 5 fc. Turn OFF is 3 to 15 fc, without the slide in position. ON/OFF adjustment shall easily be made by moving the slide cover.
6. Mounting: ½” conduit mounting with 180-degree swivel.
7. Failure Mode: Luminaire stays ON.
8. Temperature Range: -40 – 140-degree F.

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LIGHTING CONTROL DEVICES

2.3 PASSIVE INFRARED CEILING SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.

2.4 ULTRASONIC CEILING SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.

2.5 ROOM CONTROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.

2.6 LOW-VOLTAGE DIGITAL SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. The contractor shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
- F. The contractor shall install and connect the lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
- G. Communication and low voltage power shall be delivered to each device via standard low voltage network cabling with RJ-45 connectors.
- H. The contractor shall be responsible for testing of all low voltage network cable included in the bid. Contractor is responsible for verification of the following minimum parameters:
 - 1. Wire Map (continuity, pin termination, shorts and open connections, etc.).
 - 2. Length.
 - 3. Insertion Loss.

3.2 PRODUCT SUPPORT AND SERVICE (**DIGITAL LIGHTING SYSTEM ONLY**)

- A. Factory telephone support shall be available at no cost to the Owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.

3.3 SYSTEM STARTUP (**DIGITAL LIGHTING SYSTEM ONLY**)

- A. Upon completion of installation by the contractor, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
 - 1. Low voltage network cable testing shall be performed prior to system startup.
- B. System start-up and programming shall include:

1. Verifying operational communication to all system devices.
 2. Programming and verifying all sequence of operations.
 3. Customization of owner's applications.
- C. The contractor shall provide both the manufacturer with twenty-one working days written notice of the system startup and adjustment date.

END OF SECTION 260923

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for SPD as installed in panelboard.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON 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.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Height: 84 inches maximum.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- E. Incoming Mains Location: Top.
- F. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
 - 4. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Energy Management - Electrical Distribution.
 - 2. Siemens Industry, Inc., Energy Management Division.
 - 3. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Electric Company; GE Energy Management - Electrical Distribution.
 - 2. Siemens Industry, Inc., Energy Management Division.
 - 3. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.

- d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
- e. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Operating handle of the top-most circuit breaker, in the 'on' position, shall not be higher than 79 above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Make grounding connections and bond neutral for services to ground. Make connections to grounding electrodes.
- G. Install filler plates in unused spaces.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Panelboard(s) shall be offset from wall with galvanized steel slotted supports.

3.2 IDENTIFICATION

- A. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:

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PANELBOARDS

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Manual motor controllers.
4. Wall plates.

1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- ##### A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- ##### B. Comply with NFPA 70.
- ##### C. RoHS compliant.
- ##### D. Comply with NEMA WD 1.
- ##### E. Device Color: Brown.
- ##### F. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Leviton Manufacturing Co., Inc.

- c. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Extra heavy-duty, two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Termination: Back or side wire.
5. Standards: Comply with UL 498 and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Extra heavy-duty, integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Termination: Back or side wire.
6. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
7. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Extra heavy-duty, integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Feed through.
5. Termination: Back or side wire.
6. Standards: Comply with UL 498 and UL 943 Class A.
7. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 MANUAL MOTOR CONTROLLERS

- A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB (Motion Division).
 - b. Eaton.
 - c. Rockwell Automation, Inc.
 - d. Schneider Electric USA (Square D).
 - e. Siemens Industry, Inc., Energy Management Division.
 - 2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
 - 3. Configuration: Nonreversing.
 - 4. Surface mounting.
 - 5. Red pilot light.

2.5 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
 - 1. Tamperproof Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material: 0.035-inch-thick, satin-finished, Type 302 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 2. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 3. Install wiring devices after all wall preparation, including painting, is complete.
- C. Device Installation:
 - 1. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonfusible switches.
2. Enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch.

1.3 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. Comply with NFPA 70.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

A. Type GD, General-Duty:

1. Single throw.

2. Three-pole.
3. 240-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated.
6. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit (if required): Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.3 ENCLOSURES

- A. Enclosed Switches: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches: Provide enclosures at installed locations with the following environmental ratings.
 1. Indoor Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R

3.2 INSTALLATION

- A. Coordinate layout and installation of switches with equipment served and adjacent surfaces.
- B. Comply with NFPA 70 and NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

END OF SECTION 262816

SECTION 271100 - COMMUNICATIONS CABLING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. UTP cable hardware.
3. Telecommunications outlet/connectors.
4. Backboards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70.
- B. RoHS compliant.
- C. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect. This cabling and its connecting hardware are called “permanent link”, a term that is used in the testing protocols.
1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

D. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek/Ortronics a Nexans company.
2. SYSTIMAX Solutions; a CommScope Inc. brand.
3. Superior Essex and Leviton Network Solutions.

B. 100 Ohm Enhanced Category 6 Unshielded Twisted Pair (UTP) Cable:

1. Physical Characteristics:

- a. Shall be plenum rated and meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be insulated with F.E.P. No construction that use mixed insulation materials will be allowed.
- b. The diameter of the insulated conductor shall be 0.026 in. nominal.
- c. Shall consist of (4) 23 AWG twisted pairs.
- d. Shall be suitable for the environment in which they are to be installed.
- e. The color coding of pairs shall be:
 - 1) Pair 1: W-BL; BL.
 - 2) Pair 2: W-O; O.
 - 3) Pair 3: W-G; G.
 - 4) Pair 4: W-BR; BR.
- f. The overall diameter of the cable shall be no larger than 0.250 inches.
- g. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
- h. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
- i. Cable shall be third party verified to meet ANSI/TIA/EIA-568-B.2-1.

C. All horizontal data station cable and voice cable shall terminate on 110 cross-connecting blocks.

D. All cables in a cable run shall be from the same manufacturer and shall be the same type.

E. A mix of UTP cables from different manufacturers shall not be used.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek/Ortronics a Nexans company.
 - 2. SYSTIMAX Solutions; a CommScope Inc. brand.
 - 3. Superior Essex and Leviton Network Solutions.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated. Include building entrance protectors for outside plant cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cable.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.
 - 1. Metal Faceplate: Stainless steel.
- C. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.

2.6 BACKBOARDS

- A. Backboards: Plywood, 3/4 by 48 by 48 inches. Double coated in a UL 723 classified intumescent fire-retardant latex, gray in color, on all sides.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 SOURCE QUALITY CONTROL

- A. Factory test twisted pair cables according to TIA-568-C.2.
- B. Cable will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF UTP CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. Wiring Method: Install cables in raceways.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
- C. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.1.
 - 2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
 - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 - 9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- D. Separation from EMI Sources:
 - 1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

3.2 INSTALLATION OF BACKBOARD

- A. Comply with NECA 1.
- B. Backboards:

1. Install a minimum of 24 inches above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

END OF SECTION 271100

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SECTION 284621 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Carbon monoxide detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital alarm communicator transmitter.

1.2 ACTION SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level IV minimum.

B. Product Data: For each type of product, including furnished options and accessories.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.

10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. Delegated-Design Submittal: For notification appliances and smoke detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. Include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment.
 - d. Riser diagram.
 - e. Record copy of site-specific software.
 - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.

- g. Manufacturer's required maintenance related to system warranty requirements.
- h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - 2. Gamewell - FCI by Honeywell.
 - 3. Notifier.
 - 4. Siemens Industry, Inc.; Fire Safety Division.
 - 5. Silent Knight.
 - 6. SimplexGrinnell LP.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- C. All components provided shall be listed for use with the selected system.
- 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 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
 2. Smoke detectors.
 3. Carbon monoxide detectors.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Record events in the system memory.
- C. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating devices.
 3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in internal circuits of fire-alarm control unit.
 6. Abnormal ac voltage at fire-alarm control unit.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at fire-alarm control unit or annunciator.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 40 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

- C. Notification-Appliance Circuit:
 - 1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 - 2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- E. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- F. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch. System shall allow for 24-hour operation.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
 - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.
 - 3. Protective UL listed polycarbonate cover with fire label and warning horn. Manufacturers: STI or approved equal.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 4. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - 5. UL listed heavy-duty, white coated steel detector guard. Manufacturers: STI or approved equal.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.6 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 1. Mounting: Adapter plate for outlet box mounting.
 2. Testable by introducing test carbon monoxide into the sensing cell.
 3. Detector shall provide alarm contacts and trouble contacts.
 4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 5. Comply with UL 2075.
 6. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 7. Locate, mount, and wire according to manufacturer's written instructions.
 8. Provide means for addressable connection to fire-alarm system.
 9. Test button simulates an alarm condition.
 10. UL listed heavy-duty, white coated steel detector guard. Manufacturers: STI or approved equal.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.
- C. Visible Notification Appliances: Xenon or LED strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
- D. UL listed heavy-duty, white coated steel horn/strobe guard. Manufacturers: STI or approved equal.

2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- C. UL listed Type 4X clear polycarbonate cover with key lock. Manufactures: STI or approved equal.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Control Module:
 - 1. Operate notification devices.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.

4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address of the trouble-initiating device.
 4. Loss of ac supply.
 5. Loss of power.
 6. Low battery.
 7. Abnormal test signal.
 8. Communication bus failure.
- E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- C. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 2. Mount manual fire-alarm box on a background of a contrasting color.
 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- Detector Spacing: Comply with NFPA 72.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

3.2 PATHWAYS

- A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

- B. Exposed pathways shall be installed in EMT.
- C. Exposed EMT shall be red.

3.3 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- B. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- C. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621

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