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SECTION 031000 - CONCRETE FORMING AND 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. Form-facing material for cast-in-place concrete.
 - 2. Form liners.
 - 3. Insulating concrete forms.
 - 4. Shoring, bracing, and anchoring.

- B. Related Requirements:

- 1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
 - 2. Section 033000 "Cast-In-Place Concrete" for concrete materials, placement, finishing, and curing.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

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

- 1. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints

- c. Forms and form-removal limitations.
- d. Shoring and reshoring procedures.
- e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

- 1. Exposed surface form-facing material.
- 2. Concealed surface form-facing material.
- 3. Forms for cylindrical columns.
- 4. Pan-type forms.
- 5. Void forms.
- 6. Form liners.
- 7. Form ties.
- 8. Waterstops.
- 9. 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.
 - a. Location of construction joints is subject to approval of the Architect.
- 3. Indicate location of waterstops.
- 4. Indicate form liner layout and form line termination details.
- 5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

C. Samples:

- 1. For waterstops.
- 2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Field quality-control reports.
- C. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

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, 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.

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.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.
 - 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight or tapered end forms.

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
 - 1. Profile: Flat dumbbell with center bulb
 - 2. Dimensions: 4 inches by 3/16 inch 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 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.
- 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.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch-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 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, 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 to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch 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.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 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.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

- 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.
- 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 and Structural Engineer 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.
 6. Space vertical joints in walls as indicated on Drawings.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- 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 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.

3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations. Curing and protection operations need to be maintained at unformed surfaces and applied at formed surfaces immediately after removal of forms, for the remainder of the cure period.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 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.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. 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

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SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 033000 "Cast-In-Place Concrete" for concrete materials, placement, finishing, and curing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Zinc repair material.
4. Bar supports.
5. Mechanical splice couplers.
6. Structural thermal break insulated connection system.

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.

3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspection agency.
- B. Delegated Design Engineer Qualifications: Include the following:
1. Experience providing delegated design engineering services of the type indicated.
 2. Documentation that delegated design engineer is licensed in the state in which Project is located.
- C. Welding certificates.
1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- D. Material Certificates: For each of the following, signed by manufacturers:
1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
 2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- E. 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.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- C. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.
 - 1. Build panel approximately as indicated in Section 031000 "Concrete Forming and Accessories".
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.
 - 1. Store reinforcement to avoid contact with earth.
 - 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design structural thermal break insulated connection system, including attachment to building construction.
- B. Structural Performance of Structural Thermal Break Insulating Connection System: Structural thermal break insulated connection system to withstand the following loads and stresses:
 - 1. Dead Loads: As indicated on Drawings.
 - a. Shear Load: As indicated on Drawings.
 - b. Bending Moment: As indicated on Drawings.
 - 2. Live Loads: As indicated on Drawings.
 - a. Shear Load: As indicated on Drawings.
 - b. Bending Moment: As indicated on Drawings.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Deformed Bar Anchors: ASTM A496, Type C, low carbon steel, 70 ksi yield strength
- D. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- E. Galvanized Reinforcing Bars:
 - 1. Steel Bars: ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.
 - 2. Zinc Coating: ASTM A767/A767M, Class I zinc coated after fabrication and bending.
- F. Deformed bar Anchors: ASTM A1064 $F_y = 75$ ksi, deformed
- G. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- H. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, ASTM A775/A775M epoxy coated.
- C. 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 epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
 - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
 - 1. Finish: Plain
- E. Zinc Repair Material: ASTM A780/A780M.

2.4 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 to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 - 2. Stagger splices in accordance with ACI 318.

3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install Deformed Bar Anchors with electric arch stud welding.

1. Where Deformed Bar Anchor lengths are greater than can be welded by the electric arch stud welding process, lap splice shorter Deformed Bar Anchors with standard deformed Reinforcing Bars.
2. At contractor's option, Deformed Bar Anchors may be substituted with Weldable Reinforcing, ASTM A706, and welded to structure with welds capable of developing the strength of the bar in accordance with AWS D1.4.

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

3.4 INSTALLATION TOLERANCES

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

3.5 FIELD QUALITY CONTROL

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

Special Inspections shall be in accordance with Section 1705.3 of the Building Code, refer to Schedule of Special Inspections for detailed requirements.

- B. Field Quality Control: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel-reinforcement placement.
- D. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION 032000

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 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 033543 "Polishing Concrete Finishing" for polishing, sealing, and final surface treatment of concrete.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.

- e. Special concrete finish Subcontractor.
2. Review the following:
- a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.
 - f. Cold and hot weather concreting procedures.
 - g. Concrete finishes and finishing.
 - h. Curing procedures.
 - i. Forms and form-removal limitations.
 - j. Shoring and reshoring procedures.
 - k. Methods for achieving specified floor and slab flatness and levelness.
 - l. Floor and slab flatness and levelness measurements.
 - m. Concrete repair procedures.
 - n. Concrete protection.
 - o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
 - p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Performance-based hydraulic cement
- 7. Aggregates.
- 8. 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.
- 9. Color pigments.
- 10. Fiber reinforcement.
- 11. Vapor retarders.
- 12. Floor and slab treatments.
- 13. Liquid floor treatments.
- 14. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

15. Joint fillers.
16. Repair materials.

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. Steel-fiber reinforcement content.
10. Synthetic micro-fiber content.
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 - a. Amount of mixing water withheld and allowed to be added at project site is required to be included on the delivery ticket.
12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
14. Intended placement method.
15. 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 and Structural Engineer.

D. Samples: For manufacturer's standard colors for color pigment and vapor retarder.

E. 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Ready-mixed concrete manufacturer.
 - 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Vapor retarders.
 - 9. Semirigid joint filler.
 - 10. Joint-filler strips.
 - 11. Repair materials.
- C. 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. Silica fume.
 - 6. Performance-based hydraulic cement.
 - 7. Aggregates.
 - 8. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
 - 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 - 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. 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."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.
- E. Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, rustications, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Slab-On-Ground: Build panel approximately 15 feet by 15 feet in the location indicated or, if not indicated, as directed by Architect.
 - a. Divide panel into four equal panels to demonstrate saw joint cutting.
 - 2. Formed Surfaces: Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified 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. Water-Cement ratio.
 - e. Seven-day compressive strength.
 - f. 28-day compressive strength.
 - g. Standard deviation.
 - h. ACI required compressive strength
 - i. Unit weight.
 - j. Water-soluble chloride ion content determined in accordance with ASTM C1218 at age between 28 and 42 days.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with formwork or metallic embedded items, including piping and conduit less than 1/4" wall thickness, with temperatures less than 10 deg F or in contact with ground, subbase, or mud mat less than 32 deg F.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
 - a. Maintain forms, steel reinforcement, embedded items, and subgrade temperature less than 115 deg F.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

2.2 CONCRETE MATERIALS

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II.
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 IP, portland-pozzolan, Type IL, portland-limestone, Type IT, ternary blended cement.
5. Silica Fume: ASTM C1240 amorphous silica.

- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S 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. for moderately reactive aggregate or 3 lb./cu. yd. 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.

2. Maximum Coarse-Aggregate Size: 1 inch nominal.
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C330/C330M, 3/4-inch nominal maximum aggregate size.
- E. Air-Entraining Admixture: ASTM C260/C260M.
- F. 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 in steel-reinforced concrete.
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.
 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 9. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRC C48 at a hydraulic pressure of 200 psi for 14 days.
- G. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments, color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Color: As indicated by manufacturer's designation.
- H. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, except with maximum water-vapor permeance of < 0.01 not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Sheet Vapor Retarder, Class C: ASTM E1745, Class C, except with maximum water-vapor permeance of 15; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
- C. Sheet Vapor Retarder/Termite Barrier: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.03 perms; complying with ICC AC380. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Low-Temperature Flexibility: Pass at minus 15 deg F; ASTM D146/D146M.
 - 2. Puncture Resistance: 224 lbf minimum; ASTM E154/E154M.
 - 3. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
 - 4. Hydrostatic-Head Resistance: 231 feet minimum; ASTM D5385.
- D. Bituminous Vapor Retarder: ASTM E1993/E1993M, 110-mil- thick, semiflexible, seven-ply sheet membrane, consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weather coating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.
 - 1. Water-Vapor Permeance: 0.0011 grains/h x sq. ft. x inches Hg when tested in accordance with ASTM E154/E154M.
 - 2. Tensile Strength: 156 lbf/inch when tested in accordance with ASTM E154/E154M.
 - 3. Puncture Resistance: 140 lbf when tested in accordance with ASTM E154/E154M.

2.4 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
- C. Emery Dry-Shake Floor Hardener: Pigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.
 - 1. Color: As indicated by manufacturer's designation
- D. Metallic Dry-Shake Floor Hardener: Pigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture;

with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: As indicated by manufacturer's designation.

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

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

1. Color: As indicated by manufacturer's designation

2.5 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.

2.6 CURING MATERIALS

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

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

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

1. Color:

a. Ambient Temperature Below 50 deg F: Black.

b. Ambient Temperature between 50 deg F and 85 deg F: Any color.

c. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: Eight-feet- wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

E. Water: Potable or complying with ASTM C1602/C1602M.

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

G. 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.

- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.9 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.
 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. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 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.
 3. Use water-reducing admixture in pumped concrete and concrete with a w/cm below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 5. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES

- A. Normal-weight concrete used for footings and piers below grade:
 1. Exposure Class: ACI 318 F0
 2. Minimum Compressive Strength at 28 Days: 3000psi.

3. Maximum w/cm: 0.60
4. Minimum Cementitious Materials Content: 470 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch
6. Air Content: 0% to 3% Entrapped

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

1. Exposure Class: ACI 318 F0
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.48
4. Slump Limit: 3 to 5 inches
5. Air Content: 0% to 3% Entrapped

C. Normal-weight concrete used for exterior slabs-on-ground and concrete walls and retaining walls exposed to weather:

1. Exposure Class: ACI 318 F2
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 564 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch
6. Air Content: 6% +/- 1.5%

2.11 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. 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., increase mixing time by 15 seconds for each additional 1 cu. yd..
 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 EXAMINATION

- A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 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.

3.4 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, sealing vapor retarder to concrete.
 4. Lap joints 6 inches 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 on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 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 and Structural Engineer.
 - 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 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. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 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. 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- 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 or more than 1 inch 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. Diamond Dowel Plates: Install diamond dowel plates at joints where indicated on Drawings.

3.6 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 Structural Engineer 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, 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. Limit concrete freefall distance to the minimum of the following:
 - a. Smallest width of formwork in horizontal dimension less than, or equal to, twenty-four inches: Ten-foot maximum freefall.
 - b. Smallest width of formwork in horizontal dimension greater than twenty-four inches, but less than thirty-six inches: Fifteen-foot maximum freefall.
 - c. Within formwork that has cross ties, spacers, rods, reinforcing, or other embedded items: Ten-foot maximum freefall.
 - d. All other conditions: Twenty-foot maximum freefall.
 - 4. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 5. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - 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 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.

3.7 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
- B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:
 1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings or to match mockups.
 2. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi, apply scrubbed finish.
 - a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
 - b. Rinse scrubbed surfaces with clean water.
 - c. Maintain continuity of finish on each surface or area of Work.
 - d. Remove only enough concrete mortar from surfaces to match mockups.
- C. 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.

3.8 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 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 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.
4. Apply float finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system when the total air content of concrete exceeds 3 percent.
 - a. Coordinate required final finish with Architect before application.
 - b. Comply with flatness and levelness tolerances for trowel-finished floors.

D. Float and Fine-Broom Finish.

1. Immediately after float finishing, while concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route
2. Apply to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method when the total air content of concrete exceeds 3 percent.
 - a. Coordinate required final finish with Architect before application.
 - b. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten 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 to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system, where the total air content of concrete is less than 3 percent.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:

- 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.
 - 2) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
 - 3) Specified Overall Value (SOV): F_F 25 and F_L 20 with minimum local value (MLV): F_F 17 and F_L 15.
- F. Trowel and Fine-Broom Finish: Apply a first trowel finish; while concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route. Apply to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method, where total air content of concrete does not exceed 3 percent.
1. Coordinate required final finish with Architect before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- G. 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.
- H. 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. 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.
- I. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 4. After final floating, apply a trowel finish.
 5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.9 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 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches 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: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch 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.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

- a. Curing Period: 7 days, or until concrete reaches 70% of its design strength.
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 Sheeting Materials: Cover exposed concrete surfaces with sheeting 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 as follows:

1. Begin curing immediately after finishing concrete.
 - a. Curing Period: 10 days or until concrete reaches 70% of its design strength, typical. 28 days for surfaces to receive a polished concrete finish
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.
 - 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, 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.
 - 4) Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - a) Recoat areas subject to heavy rainfall within three hours after initial application.
 - b) Maintain continuity of coating and repair damage during curing period.
- 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.
 - 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.
- 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.
 - 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.

3.11 TOLERANCES

- A. Conform to ACI 117.

3.12 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.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month.
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Do not repair and patch defective areas until such repair and patch is approved by Structural Engineer.
 - a. Structural engineer will require engineered concrete repair products and details, other than those listed in this specification, where defective area affects the structural integrity of the concrete in question as determined by Structural Engineer.

2. Remove and replace concrete that cannot be repaired and patched to Architect's and Structural Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect and Structural Engineer.
- D. Repairing Unformed Surfaces:
 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.1 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.

4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks > 1/16" and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's and Structural Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's and Structural Engineer's approval.

3.15 SPECIAL INSPECTIONS AND FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports. Special Inspections shall be in accordance with Section 1705.3 of the Building Code, refer to Schedule of Special Inspections for detailed requirements.
- B. Field Quality Control: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Special Inspector 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. Special Inspector Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Special Inspector 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 Structural Engineer.
 7. Post-installed anchors in hardened concrete.
- 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., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. 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; ASTM C173/C173M volumetric method, for 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.
 5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F 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 six 6-inch by 12-inch or 4-inch by 8-inch standard cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure six standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of four laboratory-cured specimens at seven days and one set of three specimens at 28 days. Maintain remainder of specimens in reserve for later testing if required.
 - 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Structural Engineer 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 Structural Engineer.
 - 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 Structural Engineer.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 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 within 72 hours of completion of floor finishing and promptly report test results to Architect.

3.16 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 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

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

1.2 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Polished concrete finishing Subcontractor.
2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing and protection of polished concrete.

1.4 ACTION SUBMITTALS

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

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- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
- C. Samples for Verification: For each type of exposed color.

1.5 QUALITY ASSURANCE

- A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches (1200 by 1200 mm) minimum, to demonstrate the expected range of finish, color, and appearance variations.
 - 1. Locate panels as indicated or, if not indicated, as directed by Architect.
 - 2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Demolish and remove field sample panels when directed.
- B. from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

1.6 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 STAIN MATERIALS

- A. Penetrating Stain: Water-based, acrylic latex, penetrating stain with colorfast pigments. Basis of Design: Ameripolish SureLock Dye. Subject to compliance with requirements, provide the named product or comparable product but the acceptable manufacturers listed below.
 - 1. Scofield Formula One
 - 2. Prosoco Gemtone

2.2 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - 1. Densifier: Ameripolish 3D SF or approved equal.

2. Sealer: Ameripolish SR2 Plus or approved equal.

PART 3 - EXECUTION

3.1 POLISHING

- A. Polish: Level 2: Low sheen, 400 grit. Aggregate: Class B, Salt and Pepper finish.
- B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth.
 2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 4. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 5. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
 6. Control and dispose of waste products produced by grinding and polishing operations.
 7. Neutralize and clean polished floor surfaces.

3.2 PERFORMANCE REQUIREMENTS:

1. Dynamic Coefficient of Friction for polished concrete walkway surfaces, shall provide finished installation with the following values as determined by the DCOF AcuTest Method per ANSI 137.1, latest edition: Walkway Surfaces including wet areas: Minimum 0.42.
2. Concrete supplier to submit densifier to ensure finished product is more resistant to stains.
 - a. Densifier is Chemical treatment applied to concrete after grinding and initial honing.
 - b. Provide a clear liquid silicate hardener/densifier capable of permanently sealing, dustproofing, and hardening concrete surfaces and providing abrasion resistance by chemically reacting with concrete to penetrate into concrete pores, leaving no surface film or residue. Products containing silicanates are not permitted.

3.3 STAINING

- A. Newly placed concrete to be at least 30 days old before staining.

- B. Prepare surfaces according to manufacturer's written instructions and as follows, and confirm surface conditions are appropriate to receive dye:
 - 1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
 - a. Do not use acidic solutions to clean surfaces.
 - 2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
 - 3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
 - 4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F710 to ensure pH is between 7 and 8.
- C. Scoring: Score decorative jointing in concrete surfaces 1/16 inch (1.6 mm) deep with diamond blades to match pattern indicated. Rinse until water is clear. Score before staining.
 - 1. Joint Width: 3/8 inch (10 mm).
- D. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D4263 by tightly taping 18-by-18-inch (450-by-450-mm), 4-mil- (0.1-mm-) thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
- E. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
 - 1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
 - 2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 - 3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

3.4 Sealing

- A. Densifier: Apply densifier to concrete surfaces according to manufacturer's written instructions and as follows:
 - 1. Allow dye to completely dry
 - 2. Apply Densifier.

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- B. Sealer: Apply sealer to concrete surfaces according to manufacturer's written instructions and as follows:
1. Allow densifier to completely dry
 2. Apply Sealer.
 3. When dry to the touch, burnish floor.

END OF SECTION 033543

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Embedded flashing.
6. Miscellaneous masonry accessories.
7. Masonry-cell fill.

B. Related Requirements:

1. Section 031000 "Concrete Forms and Accessories" for masonry anchors.
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 071326 "Self-Adhering Sheet Waterproofing" for application to masonry walls where indicated.
4. Section 072726 "Fluid-Applied Membrane Air Barrier" for application to masonry walls where indicated.
5. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
6. Section 079200 "Joint Sealants" for sealants in masonry walls.
7. Section 081113 "Hollow Metal Doors and Frames" for frames to be anchored into masonry walls.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting masonry shop drawings, examine procedures for ensuring quality of concrete masonry construction. Require representatives of each entity directly concerned with concrete masonry to attend, including the following:
 - a. Contractor's superintendent.
 - b. Mason

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- c. Architect.
- d. Masonry Supplier.

2. Topics

- a. Review hot and cold weather procedures
- b. Review shop drawing procedures and expectations.
- c. Discuss Coordination requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

- 1. Masonry Units: Show sizes, profiles, coursing, locations of special shapes, control joint locations, and elevations showing all openings with masonry lintels.
- 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
- 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

- 1. Masonry units.
 - a. Include data on material properties and material test reports substantiating compliance with requirements.
 - b. For masonry units include data and calculations establishing average net-area compressive strength of units.
- 2. Integral water repellant used in CMUs.
- 3. Cementitious materials. Include name of manufacturer, brand name, and type.
- 4. Mortar admixtures.
- 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
- 6. Grout mixes. Include description of type and proportions of ingredients.
- 7. Reinforcing bars.
- 8. Joint reinforcement.
- 9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

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1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602/ACI 530.1/ASCE 6.
- E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

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- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602/ACI 530.1/ASCE 6.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
- C. CMUs: ASTM C90-90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 - 2. Density Classification: Lightweight, unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.

2.5 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 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.
 - 1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.
- 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. Aggregate for Mortar: ASTM C144, natural sand.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
- E. 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.
- F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- G. Water: Potable.

2.7 REINFORCEMENT

- A. Masonry-Joint Reinforcement, General: Ladder type complying with 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: 0.187-inch (4.76-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.187-inch (4.76-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.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

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1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating, minimum 9-gauge.
 2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch- (2.66-mm-) thick steel sheet, galvanized after fabrication.
 - a. 0.064-inch- (1.63-mm-) thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.
 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.
- E. 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.

2.9 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Asphalt-Coated Copper Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
- B. 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.
- C. 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.

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2.10 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).

2.11 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.

2.12 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, masonry cement or mortar cement mortar unless otherwise indicated.
 - 3. For exterior masonry, use Portland cement-lime, masonry cement or mortar cement mortar.
 - 4. For reinforced masonry, use Portland cement-lime, masonry cement or mortar 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 or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.

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3. 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.
 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. 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 in accordance with ASTM C143/C143M.
- E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

- C. 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.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
- 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
- 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
- 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

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3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: 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. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. 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.
- G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
 - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:

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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. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

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. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 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. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 4. 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.

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- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 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 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).

3.12 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 is done at Contractor's expense.
- B. Inspections: Special inspections in accordance with 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.

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- 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, in accordance with ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

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- B. Masonry Waste Recycling: Return broken CMUs to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste, 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 materials.
2. Shrinkage-resistant grout.
3. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099600 "High Performance Coatings" for coating materials, surface preparation, and application of coatings.
4. Section 055213 "Pipe and Tube Railings" for railing that attach to structural steel.
5. Section 042200 "Concrete Unit Masonry" for masonry units, mortar requirements, reinforcement, and installation tolerances.
6. Section 061516 "Wood Roof Decking" for tongue and groove decking attached to structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches (38 mm).
 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 3. Column base plates thicker than 2 inches (50 mm).

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

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

1.5 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.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

- D. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation. In addition, the professional

engineer responsible for connection design shall review the shop drawings prior to submittal to verify that the connections detailed comply with the calculations provided as well as the design requirements. A review letter, signed and sealed by the professional engineer responsible for connection design, shall be provided with the shop drawings and calculations submittal stating that this review and verification has been completed.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.7 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. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by

AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

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 341.
 - 3. ANSI/AISC 360.
 - 4. 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 selects or completes 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.

3. Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.
 - a. Use Load and Resistance Factor Design; data are given at factored-load level.
 4. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
 - a. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, 50 ksi (345 MPa).
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- 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. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1 (Type 10.9-1), compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength 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 or mechanically deposited zinc coating.
 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.
- D. 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: Plain or Mechanically deposited zinc coating as indicated.
- E. 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 36.
 1. Configuration: Straight.
 2. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
 3. Plate Washers: ASTM A36/A36M carbon steel.
 4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 5. Finish: Plain.
- B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
 1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
 2. Plate Washers: ASTM A36/A36M carbon steel.
 3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 4. Finish: Plain.
- C. Threaded Rods: ASTM A36/A36M.
 1. Nuts: ASTM A63 (ASTM A563M) heavy-hex carbon steel.
 2. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
 3. Finish: Plain.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 099600 "High Performance Coating."
 - 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: MPI#26.
 - 1. Etching Cleaner: MPI#25, for galvanized steel.
 - 2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20. ASTM A780/A780M.

2.7 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.

2.8 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.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. 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.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 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.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 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. Galvanize lintels shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.11 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. Corrosion-resisting (weathering) steel surfaces.
 7. 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 14 (WAB)/NACE WAB-8.
 5. SSPC-SP 11.
 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 7. SSPC-SP 10 (WAB)/NACE WAB-2.
 8. SSPC-SP 5 (WAB)/NACE WAB-1.
 9. SSPC-SP 8.
- 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.
- 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.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will 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 and test 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 for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 - 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 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. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack 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.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 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.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 099600 "High Performance Coating".
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 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: Owner will engage a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect and test 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.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

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SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 78100 "Applied Fire Protection" for spray applied fireproofing at rated floor assembly.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated

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. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

- E. Qualification Statements: For welding personnel and testing agency.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 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."
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

PART 2 - PRODUCTS

2.1 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G30 zinc coating.
 - 2. Profile Depth: As indicated on drawings
 - 3. Design Uncoated-Steel Thickness: As indicated on drawings
 - 4. Span Condition: As indicated on drawings

2.2 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 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, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated, or if not indicated as recommended by SDI standards for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch 0.0747 inch thick, with factory- punched hole of 3/8-inch minimum diameter.
- I. 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.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A780/A780M SSPC-Paint 20 with dry film containing a minimum of 94 percent zinc dust by weight.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions 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, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.

- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch nominal.
 - 2. Weld Spacing: Not more than 12 inches apart, or as indicated on drawings.
 - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 - 1. Fasten with a minimum of 1-1/2-inch long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
3. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports. Special Inspections shall be in accordance with Section 1705.2.2 of the Building Code, refer to Schedule of Special Inspections for detailed requirements.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections:
1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 2. Steel decking will be considered defective if it does not pass tests and inspections.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- D. Prepare test and inspection reports.

END OF SECTION 053100

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal downspout boots.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 044200 "Concrete Unit Masonry."
2. Section 077100 "Roof Specialties" for downspouts.
3. Section 099600 "High Performance Coatings" for painting steel surfaces.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:

1. Loose steel lintels.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- D. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
- E. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.
- F. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- G. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- H. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, 0.050 inch (1.27 mm) thick.
 - a. Finish: No. 4.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- G. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

COUNTY OF WAKE

LAKE MYRA COUNTY PARK PHASE 1

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.

COUNTY OF WAKE

LAKE MYRA COUNTY PARK PHASE 1

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 METAL DOWNSPOUT BOOTS

- A. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- B. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 1. Outlet: Vertical, to discharge into pipe.
 2. Height: Two feet above grade.
- C. Prime cast-iron downspout boots with primer specified in Section 099600 "High-Performance Coatings."

2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with primer specified in Section 099600 "High-Performance Coatings."

2.9 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.11 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

COUNTY OF WAKE

LAKE MYRA COUNTY PARK PHASE 1

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF METAL DOWNSPOUT BOOTS

- A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.
- B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.3 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with precast concrete treads.
2. Preassembled steel stairs with composite decking treads.

B. Related Requirements

1. Section 033000 "Cast-in-Place Concrete" for interior stair treads.
2. Section 055213 "Pipe and Tube Railings" for Railings and Guardrails
3. Section 061533 "Composite Decking" for composite stair treads on exterior stairs.
4. Section 099600 "High Performance Coatings" for painting steel.

C. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

D. Coordinate installation of anchorages for metal stairs and railings.

1. Furnish setting drawings, templates and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

E. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

F. Schedule installation of railings so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.2 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Prefilled metal-pan-stair treads.
2. Abrasive nosings.
3. Shop primer products.

B. Shop Drawings:

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1. Include plans, elevations, sections, details and attachments to other work.
 2. Indicate sizes of metal sections, thickness of metals, profiles, holes and field joints.
 3. Include plan at each level.
- C. Delegated Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect steel members and packaged materials from corrosion and deterioration.
 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

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- C. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- E. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 FASTENERS

- A. General: Provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.
 - 1. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs and stairs indicated to be galvanized.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

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2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593, and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for exterior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
- H. Stair Treads
 1. Composite Wood Treads:
 - a. Comply with requirements in Section 06 1533 "Composite Decking." For exterior stair treads.
 2. Precast Concrete Treads:
 - a. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi (20 MPa) and maximum aggregate size of 1/2 inch (13 mm) unless otherwise indicated.
 - b. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

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- c. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, galvanized steel, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.
- I. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
 - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
- J. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

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1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 1. Stringers: Fabricate of steel plates or steel channels or steel rectangular tubes as indicated on Drawings.
 - a. Stringer Size: As required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Factory Primed to be field painted.
 2. Platforms: Construct of steel plate or steel channel or steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Factory Primed to be field painted.
 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subread pans and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
 1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 2. Galvanized Steel Sheet: Galvanized steel sheet.

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3. Directly weld metal pans to stringers; locate welds on top of subreads where they will be concealed by concrete fill. Do not weld risers to stringers.
4. Shape metal pans to include nosing integral with riser.
5. Attach abrasive nosings to risers.
6. At Contractor's option, provide stair assemblies with metal pan subreads filled with reinforced concrete during fabrication.
7. Provide subplatforms of configuration indicated or, if not indicated, the same as subreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.7 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- E. Unless otherwise indicated, metal to be field painted per section 09 9600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedded items for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

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1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
 1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Install precast concrete treads according to manufacturer's written instructions.

3.3 REPAIR

- A. Touchup Painting:
 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

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2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."
- B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055113

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel handrails.

B. RELATED REQUIREMENTS:

1. Section 057300 "Decorative Metal Railings" for guardrails and illuminated handrails.
2. Section 099600 "High Performance Coatings" for paint systems for handrails.
3. Section 265600 "Exterior Lighting" for power to the illuminated handrails.

1.2 COORDINATION

- A.** Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B.** Coordinate installation of anchorages for railings. Furnish setting drawings, templates and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Fasteners.
3. Post-installed anchors.
4. Handrail brackets.
5. Shop primer.
6. Bituminous paint.
7. Nonshrink, nonmetallic grout.
8. Anchoring cement.
9. Metal finishes.

- B.** Shop Drawings: Include plans, elevations, sections, details and attachments to other work.

- C.** Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

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- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A500/A500M (cold formed)] or ASTM A513/A513M, Type 5.
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.
- E. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Steel Railing Components: Steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast steel, center of handrail 2-1/2 inches (63.5 mm) from wall.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

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- C. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- D. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
1. By bending or by inserting prefabricated elbow fittings.
- K. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, flanges, miscellaneous fittings and anchors to interconnect railing members to other work unless otherwise indicated.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 2. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

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- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
- D. Shop-Painted Finish: Comply with Section 099600 "High-Performance Coatings."
 - 1. Color: As indicated in drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to

railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, attached to post with setscrews.

3.4 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with flange tapped for concealed anchorage.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

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3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 057300 - SPECIALTY METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel guardrails
2. Illuminated Handrails

B. RELATED REQUIREMENTS:

1. 051200 "Structural Steel Framing" for beams to attach railings to.
2. 055113 "Metal Pan Stairs" for stairs to receive guard rails.
3. 055213 "Pipe and Tube Railings" for non-illuminated handrails.
4. 099600 High Performance Coatings for paint systems for guardrails and handrails.
5. 265600 "Exterior Lighting"

C. COORDINATION AND SCHEDULING

- D. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- E. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

A. Product Data:

1. Illuminated rails.
2. Bar Steel
3. Fasteners.
4. Post-installed anchors.
5. Handrail brackets.
6. Shop primer.
7. Bituminous paint.

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8. Nonshrink, nonmetallic grout.
9. Anchoring cement.
10. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

1. For illuminated railings, include wiring diagrams and roughing-in details.
2. For bar steel guardrails.

C. Samples for Verification: For each type of exposed finish required.

- a. A twelve inch section of illuminated handrail, showing handrail construction and finish.

D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

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."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for guardrail, consisting of three posts, top rail, infill area, and anchorage system components that are full height and are not less than 8 feet in length, and including a corner
2. Build mockups for handrail, consisting of two posts, rail, and lighting.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 STEEL GUARDRAILS

- A. Source Limitations: Obtain steel guardrail components from single source from single manufacturer.
- B. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- C. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.

2.4 ILLUMINATED HANDRAILS

- A. Source Limitations: Obtain illuminated handrail components from single source from single manufacturer.
- B. Illuminated Handrails: Provide internal illumination using concealed, internally wired, integrated LED lamps to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Artec Lighting Products, Inc.
 - b. Intense Lighting.
 - c. Wagner.
 - 2. Construction: Minimum 1-1/2-inches (38.1 mm) diameter handrail constructed of extruded aluminum with polycarbonate lens and stainless steel jacket.
 - 3. LED Luminaires: Comply with Section 265600 "Exterior Lighting" and as follows:
 - a. Lamp Type: Linear
 - b. Light Illumination: White, standard output; 120 lumens/300 mm
 - c. Efficacy: Minimum 80 lm/W.
 - d. Color Rendering Index: Minimum 80
 - e. Correlated Color Temperature: 3500 K >.
 - f. Rated Lamp Life: 50,000 hours at 70 percent lamp illumination output.
 - g. Beam Distribution: Symmetrical 25 degrees.
 - h. LED Diffuser: UV-stabilized acrylic, clear matching rail profile.
 - i. Nominal Operating Voltage: 120 V ac output.
 - j. Internal Driver: 120 W.
 - k. UL Listing: Damp
 - l. IP Rating: IP67.
 - m. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 FASTENERS

A. Fastener Materials:

1. Aluminum Railing Components: Type 304 stainless steel fasteners.
2. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
3. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
4. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
5. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 and nuts, ASTM F594.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

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- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

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2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.
- I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
1. By bending or by inserting prefabricated elbow fittings.
- K. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 2. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other

components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces.
 - 3. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Stainless Steel Tubing Finishes:
 - 1. 180-Grit Polished Finish: Uniform, directionally textured finish.
- D. Stainless Steel Sheet and Plate Finishes:
 - 1. Directional Satin Finish: ASTM A480/A480M, No. 4.

2.10 STEEL FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
 - 2. Other Railings: SSPC-SP 7/NACE No. 4.
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated railings with primers specified in Section 099600 "High-Performance Coatings."
- D. Field-Painted Finish: Comply with Section 099600 "High-Performance Coatings."
 - 1. Color: As indicated in drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Anchor posts to surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For illuminated handrails, weld post to base plate, and bolt base plate through decking to structure, as indicated in drawings.
 - 2. For steel guardrails, weld flanges to sides of metal structure as indicated in drawings.

3.4 ATTACHING RAILINGS

- 1. Attach illuminated handrails to steel posts as provided by manufacturer, and anchor to stair treads, ramp surface, or concrete as indicated on drawings.

3.5 ATTACHING GUARDRAILS

- A. Attach guardrails to steel beams as indicated in drawings.

3.6 REPAIR

- A. Clean up metalwork prior to field painting:
 - 1. Repair and smooth field welds, bolted connections, burrs, pinholes, and abraded areas.
 - 2. Touch up shop primer.

3.7 CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

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3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 061000 - ROUGH CARPENTRY – STRUCTURAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preserved-treated lumber.
3. Preservative treated plywood.
4. Fire-retardant-treated lumber.
5. Miscellaneous lumber.

B. Related Requirements:

1. Section 061533 "Composite Decking" for elevated decks, including support framing.
2. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
3. Section 074114 "Standing Seam Metal Roof Panels" for metal roof system
4. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for single ply roofing system.
5. Section 313116 "Termite Control" for site application of borate treatment to wood framing.
6. Section 062013 "Exterior Finish Carpentry" for wood slat wall framing.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WCLIB: West Coast Lumber Inspection Bureau.
 5. WWPA: Western Wood Products Association.

1.3 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 in accordance with 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 4. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
1. Boards: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
 - 1. UC1: Interior construction not in contact with ground or subject to moisture. Include all rough carpentry.
 - 2. UC2: Interior construction not in contact with ground but may be subject to moisture.
 - a. Wood sills, sleepers, blocking and similar concealed members in contact with masonry or concrete.
 - 3. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include the following items:
 - a. Wood cants, nailers and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 4. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 5. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
 - 6. After treatment, redry to 19 percent maximum moisture content.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: Exterior grade, AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers and waterproofing.

2.4 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to 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 in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings and the following:
 - 1. Concealed blocking.
 - 2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 - 3. Plywood backing panels.

2.5 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Cants.
 - 4. Furring.

5. Grounds.

- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
1. Mixed southern pine or southern pine; SPIB.
 2. Spruce-pine-fir; NLGA.
 3. Hem-fir; WCLIB or WWPA.
 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 5. Eastern softwoods; NeLMA.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine or southern pine; No. 2 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.
 4. Eastern softwoods; No. 2 Common grade; NeLMA.
- D. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- E. 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.
- 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 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.7 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- B. Nails, Brads, and Staples: ASTM F1667.

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- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction and as appropriate for the substrate.

2.8 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to substrate; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. 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.
- E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

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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.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- F. 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.
- G. Comply with AWPAC 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.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. ICC-ES evaluation report for fastener.
- J. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- 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.

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- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061500 - ROUGH CARPENTRY - ARCHITECTURAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preserved-treated lumber.
3. Preservative treated plywood.
4. Fire-retardant-treated lumber.
5. Miscellaneous lumber.

B. Related Requirements:

1. Section 061533 "Composite Decking" for elevated decks, including support framing.
2. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
3. Section 074114 "Standing Seam Metal Roof Panels" for metal roof system
4. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for single ply roofing system.
5. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WCLIB: West Coast Lumber Inspection Bureau.
 5. WWPA: Western Wood Products Association.

1.3 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 in accordance with 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 4. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 - 1. Boards: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
 - 1. UC1: Interior construction not in contact with ground or subject to moisture. Include all rough carpentry.
 - 2. UC2: Interior construction not in contact with ground but may be subject to moisture.
 - a. Wood sills, sleepers, blocking and similar concealed members in contact with masonry or concrete.
 - 3. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include the following items:
 - a. Wood cants, nailers and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 4. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 5. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
 - 6. After treatment, redry to 19 percent maximum moisture content.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: Exterior grade, AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers and waterproofing.

2.4 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to 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 in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings and the following:
 - 1. Concealed blocking.
 - 2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 - 3. Plywood backing panels.

2.5 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Cants.
 - 4. Furring.

5. Grounds.

- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
1. Mixed southern pine or southern pine; SPIB.
 2. Spruce-pine-fir; NLGA.
 3. Hem-fir; WCLIB or WWPA.
 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 5. Eastern softwoods; NeLMA.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine or southern pine; No. 2 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.
 4. Eastern softwoods; No. 2 Common grade; NeLMA.
- D. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- E. 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.
- 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 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.7 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- B. Nails, Brads, and Staples: ASTM F1667.

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- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction and as appropriate for the substrate.

2.8 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to substrate; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. 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.
- E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

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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.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- F. 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.
- G. Comply with AWPA 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.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. ICC-ES evaluation report for fastener.
- J. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- 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.

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- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061500

SECTION 061516 - WOOD ROOF DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-sawn wood roof decking.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with wood roof decking.
2. Section 061600 "Sheathing" for material requirements, fastening schedules, and substrate tolerances for sheathing.
3. Section 074114 "Standing Seam Metal Roof" for roof systems installed on wood decking.
4. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for roof systems install on metal decking.
5. Section 076200 "Sheet Metal Flashing and Trim"
6. Section 099300 "Staining and Transparent Finishing"

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For glued-laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.
2. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

B. Samples: 24 inches long, showing the range of variation to be expected in appearance of wood roof decking.

1.3 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.

- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.1 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.2 SOLID-SAWN WOOD ROOF DECKING

- A. Standard for Solid-Sawn Wood Roof Decking: Comply with AITC 112.
- B. Roof Decking Species:
 - 1. Douglas fir-larch, Douglas fir-larch (North), southern pine.
- C. Roof Decking Nominal Size: 2 by 6.
- D. Roof Decking Grade:
 - 1. Select Decking.
- E. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.
- F. Moisture Content: Provide wood roof decking with 19 percent maximum moisture content at time of dressing.
- G. Face Surface: Rough sanded or wire brushed.
- H. Edge Pattern: Bullnosed or Channel grooved.

2.3 PRESERVATIVE TREATMENT

- A. Pressure treat wood roof decking in accordance with AWWPA U1; Use Category UC2.
 - 1. For laminated roof decking, treat lumber before gluing.
- B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 1. For exposed items indicated to receive a stained or natural finish, use products that do not contain colorants, bleed through, or otherwise adversely affect finishes.

- C. Use process that includes water-repellent treatment.
- D. Use process that does not include water repellents or other substances that might interfere with application of indicated finishes.
- E. After treatment, redry materials to 19 percent maximum moisture content.
- F. After dressing and fabricating roof decking, apply inorganic boron in accordance with AWWA M4 to surfaces cut to a depth of more than 1/16 inch.

2.4 ACCESSORY MATERIALS

- A. Fasteners for Solid-Sawn Roof Decking: Provide fastener size and type complying with AITC 112 for thickness of deck used.
- B. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- C. Nails: Common; complying with ASTM F1667, Type I, Style 10.
- D. Spikes: Round; complying with ASTM F1667, Type III, Style 3.
- E. Fastener Material: Hot-dip galvanized steel.
- F. Bolts for Anchoring Roof Decking to Walls: Carbon steel; complying with ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers, all hot-dip zinc coated.
- G. Installation Adhesive: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide adhesive that complies with research/evaluation report.
- H. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
- I. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

2.5 FABRICATION

- A. Shop Fabrication: Where preservative-treated roof decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.
- B. Predrill roof decking for lateral spiking to adjacent units to comply with AITC 112.
- C. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer.

- D. Apply indicated finish materials to comply with Section 099300 "Staining and Transparent Finishing" in fabrication shop.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install solid-sawn wood roof decking to comply with AITC 112.
 - 1. Locate end joints for two-span continuous lay-up.
- B. Anchor wood roof decking, where supported on walls, with bolts as indicated.
- C. Where preservative-treated roof decking must be cut during erection, apply a field-treatment preservative to comply with AWWPA M4.
 - 1. For solid-sawn roof decking, use inorganic boron (SBX).
 - 2. For laminated roof decking, use copper naphthenate.
- D. Apply joint sealant to seal roof decking at exterior walls at the following locations:
 - 1. Between roof decking and supports located at exterior walls.
 - 2. Between roof decking and exterior walls that butt against underside of roof decking.
 - 3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

3.4 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.

- B. If, despite protection, roof decking becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

3.5 SPECIAL INSPECTIONS

- A. Special Inspections and tests shall be performed by the Special Inspector or Special Inspection Agency.
- B. Verification and inspection of rough carpentry construction shall be in accordance with Section 1705.5 of North Carolina State Building Code 2018, and as follows:
 - 1. Details: Perform an inspection of the to verify compliance with the details shown on the approved construction documents such as member sizes and locations, bracing, stiffening, and proper application of joint details at each connection.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Additional testing performed to determine compliance of corrected work with specified requirements shall be at Contractor's expense.

END OF SECTION 061516

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SECTION 061533 - COMPOSITE DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composite plastic decking.

B. Related Sections:

1. Section 055113 "Metal Pan Stairs" for stairs to receive composite treads.
2. Section 061000 "Rough Carpentry" for wood framing.

1.2 REFERENCES:

A. Reference Standards:

1. ASTM International (ASTM).
 - a. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - b. ASTM D1037 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
 - c. ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - d. ASTM D1761 Standard Test Methods for Mechanical Fasteners in Wood.
 - e. ASTM D7032 Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite and Plastic Lumber Deck Boards, Stair Treads, Guards, and Handrails.
 - f. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
2. American Wood Council (AWC).
 - a. AWC NDS National Design Specification for Wood Construction.
3. American Wood Protection Association (AWPA).
 - a. AWPA E1 Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termite.
4. International Codes Council (ICC).
 - a. ICC- ES AC174 Acceptance Criteria for Deck Board, Span Ratings and Guardrail Systems (Guards and Handrails).

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's standard specifications and descriptive literature, including:
 - 1. Manufacturer's product technical data sheets.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings
 - 1. Layout, including decking orientation
 - 2. Connection and attachment details
 - 3. Edge details
- C. Samples: One 4 inch long decking sample illustrating size, profile, color, and surface finish.
- D. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria, and physical requirements.
- E. Warranty: Manufacturer's published warranty document, including:
 - 1. Manufacturer's 50-year structural warranty, from date of substantial completion, covering defects in materials.
 - 2. Manufacturer's 30-Year fade and stain warranty.
- F. Maintenance Data: Manufacturer's instructions on care and cleaning of composite wood

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in accordance with manufacturer's written instructions.
 - 1. Deliver materials in manufacturer's original, unopened, undamaged packaging with identification labels intact and product name and manufacturer clearly visible and sizes to suit project.
 - 2. Store materials protected from exposure to harmful environmental conditions, clean, dry, frost-free and at recommended temperature and humidity levels.
 - a. Store composite wood level and flat, off ground or floor, with supports at each end and maximum 24 inches on center.
 - b. Do not stack composite wood to heights greater than 8 feet high.
 - c. Cover composite wood with waterproof covering, vented to prevent moisture buildup.

PART 2 - PRODUCTS

2.1 COMPOSITE PLASTIC DECKING AND EXTERIOR STAIR TREADS

- A. Basis of Design: Composite decking is based on products manufactured by MoistureShield. Subject to compliance with requirements. Provide the named products or comparable products by one of the following:
 - 1. TimberTech.
 - 2. Trex Company Inc.
- B. Decking: Slip, scratch, mold and mildew resistant composite wood decking with high recycled content and approved for direct ground and water contact.
- C. Decking: Reclaimed wood and polyethylene plastic with additives for coloring and inhibiting fungal and algal growth; free from toxic chemicals.
 - 1. Profiles:
 - a. Deck Board: 1x5.4 inches x 16' long with edge grooves for concealed fastening.
 - b. Series: Elevate
 - c. Color: LakeFog
 - d. Surface Texture: Manufacturer's standard slip-resistant texture
 - e. Recycled Content:
 - 1) 95% total recycled content

2.2 FASTENERS

- A. Mechanical Fasteners: To ASTM D1761.
 - 1. Stainless steel composite wood screws of length in accordance with composite decking manufacturer's written recommendations.
- B. Hidden Fasteners:
 - 1. Stainless steel deck clips capable of elevating deck boards above joists.
 - a. Manufacturer's standard hidden fasteners
 - 2. Plastic deck clips with Stainless steel pre-inserted screw.
 - a. Manufacturer's standard hidden fasteners

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for composite wood decking installation in accordance with manufacturer's written recommendations.
 - 1. Visually inspect substrate in presence of consultant.
 - 2. Inform consultant of unacceptable conditions immediately upon discovery.
 - 3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
 - 4. Starting installation of composite wood decking implies substrate conditions are acceptable for Work of this Section.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

- A. Install composite wood decking in accordance with manufacturer's written recommendations.
- B. Do not use composite decking material for structural applications.
- C. Deck Design: To AWC NDS.
- D. Layout and install joists at 16 inch maximum on center when decking will be installed perpendicular to joists and 12 inch maximum on center when deck boards will be installed at an angle to joists.
 - 1. Do not exceed maximum spans in accordance with manufacturer's written recommendations.
 - 2. Ensure joists are level, plumb and square.
- E. Install deck boards in pattern indicated to joists with hidden fastener deck clips and secure with mechanical fasteners.
 - 1. Use 2 fasteners at each joist support.
 - 2. Allow 1/4 inch side-to-side spacing between deck boards.
 - 3. Allow 1/8 inch minimum end-to-end spacing at butt joints between deck boards.
 - a. Stagger butt joints on decks longer than 20 feet.
 - b. Stagger butt joints in adjacent rows.
 - c. Install sister joists to support butt joint ends as needed.
 - 4. Cut deck boards true and square to length after securing.
 - 5. Install fascia trim boards as indicated.

3.4 CLEANING

- A. Perform daily progress cleaning.
 - 1. Leave work area clean at end of each day.
- B. Upon completion, remove surplus materials, rubbish, tools and equipment.
- C. Collect recyclable waste and dispose of at appropriate recycling facilities.
- D. Final Cleaning: Clean composite wood surfaces according to manufacturer's maintenance guidelines.

3.5 PROTECTION

- A. Protect applied composite wood decking from damage during construction.
- B. Repair or replace adjacent materials damaged by installation of composite wood decking.

END OF SECTION 061533

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 071326 "Self-Adhering Sheet Waterproofing" for waterproofing applied to face of sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling.

1.3 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.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing 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.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed, LLC.
 - 3. Gold Bond Building Products.
 - 4. U.S. Gypsum.
- B. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.
 - 1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
 - 2. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF GYPSUM SHEATHING

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

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- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior slat screen lumber at Maintenance Facility

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for pipe columns to receive wood slat screen.
2. Section 099300 "Staining and Transparent Finishing" for wood stain.

1.2 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.

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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Samples for Verification:

1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber 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.

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or 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.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
 - 2. For exposed lumber, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Water-Repellent Preservative Treatment by Nonpressure Process: AWWA N1; dip, spray, flood, or vacuum-pressure treatment.
 - 1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chlorpyrifos (CPF).
 - 2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
 - 3. Application: Exterior wood slat screen lumber.

2.3 EXTERIOR LUMBER

- A. Lumber Trim for Transparent Finish (Stain and Clear Finish):
 - 1. Species and Grade: Southern pine; pressure-preservative treated; SPIB B & B.

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- a. Maximum Moisture Content: 19 percent.
2. Finger Jointing: Not allowed.
3. Face Surface: Surfaced (smooth).
4. Finish: Stain per section 099300.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
 1. For pressure-preservative-treated wood, provide stainless steel fasteners.
 2. For applications not otherwise indicated, provide stainless steel or hot-dip galvanized-steel fasteners.
- B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

2.5 FABRICATION

- A. Back out or kerf backs of standing and running trim wider than 5 inches (125 mm), except members with ends exposed in finished work.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

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. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.
 1. Cut to required lengths and prime ends.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
- B. Install exterior finish carpentry level, plumb, true and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut exterior finish carpentry to fit adjoining work.
 - 3. Refinish and seal cuts as recommended by manufacturer.
 - 4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
 - 5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
 - 6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 INSTALLATION OF SLAT SCREEN LUMBER

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger end joints in adjacent and related members.
- C. Fit exterior joints to exclude water.
 - 1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
 - 2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

3.5 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
 - 1. Exterior 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.

3.6 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 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 062013

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Paneling.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 064116 "Plastic Laminate-Faced Architectural Cabinets" for laminate casework.
3. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.

1.2 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.

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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Samples for Verification:

1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation.

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1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 2. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.4 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.
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.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Hardboard: ANSI A135.4.
- C. Softwood Plywood: DOC PS 1.

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish)
1. Species and Grade: Baltic Birch; NHLA Clear.
 2. Maximum Moisture Content: 9 percent.

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3. Glueing for Width: Allowed
4. Face Surface: Surfaces smooth.
5. Matching: Selected for compatible grain and color.

B. Lumber Trim for Opaque Finish (Painted Finish):

1. Eastern white pine; NeLMA or NLGA 1 Common.
2. Maximum Moisture Content: 9 percent.
3. Finger jointing: Allowed.
4. Face Surface: Surfaces smooth.

2.3 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.

1. Face Veneer Species and Cut: Rift-Sawn Baltic Birch.
2. Veneer Matching: Slip Match.
3. Backing Veneer Species: Any hardwood compatible with face species.
4. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

C. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

2.5 FABRICATION

A. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

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.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 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 semi-exposed 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

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SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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. Plastic-laminate-faced architectural cabinets and shelves.
 - 2. Cabinet hardware.
- B. Related Requirements:
 - 1. Section 06 1000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
 - 2. Section 064113 "Wood Veneer-Faced Architectural Cabinets" for wood veneer faced casework.
 - 3. Section 12 3661 "Simulated Stone Countertops" for solid surface material and quartz countertops.

1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including high-pressure decorative laminate and cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for items installed in architectural plastic-laminate cabinets.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.

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C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
2. Thermoset decorative panels, 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for

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trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS (PL-1, PL-2, PL-3)

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by manufacturers complying with AWI Standards.
- B. Grade: Premium.
- C. Type of Construction: Face frame.
- D. Cabinet, Door and Drawer Front Interface Style: Flush overlay.
- E. Reveal Dimension: 1/4 inch (13 mm).
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
 - 1. Manufacturers: Subject to compliance with requirements, provide the products by one of the following:
 - a. Wilsonart
 - b. Formica
 - c. Aborite
- G. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edge Banding: 3mm PVC. Provide matching laminate edges where indicated.
 - 5. Pattern Direction: Vertically for drawer fronts, doors and fixed panels.
- H. Materials for Semi-exposed Surfaces:

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1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC edge banding.
3. Drawer Bottoms: Thermoset decorative panels.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Colors, Patterns and Finishes: See Finish Legend.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 1. Hardboard: AHA A135.4.
 2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
 3. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- B. Wire Pulls: See Finish Legend.

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- C. Catches: Magnetic catches, BHMA A156.9, B03141.
- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
 - 1. Basis of Design: Rakks Style BR2-14 with retaining pin.
 - 2. Surface-mounted C-Standards SC.
 - 3. Color: Clear anodized.
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted, full-overtravel-extension type, zinc-plated steel ball-bearing slides.
- G. Door Locks: ANSI/BHMA A156.11, E07121.
- H. Drawer Locks: ANSI/BHMA A156.11, E07041.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA finish as selected by the Architect.
 - 1. Satin Stainless Steel: ANSI/BHMA 630.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

- A. Fabricate cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

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1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- B. Install cabinets level, plumb, true and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 1. Use filler matching finish of items being installed.
- E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

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3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

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SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, emulsified-asphalt dampproofing.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.

1.2 ACTION SUBMITTALS

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

1.3 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

- A. VOC Content: Products are to comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

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2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Trowel Coats: ASTM D1227, Type II, Class 1.
- B. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.
- C. Brush and Spray Coats: ASTM D1227, Type III, Class 1.
- D. Location: At concrete wall between Basement and Crawlspace.

2.4 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.
- D. Extruded-polystyrene board insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.
- B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

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- D. Apply patching compound to patch and fill tie holes, honeycombs, reveals and other imperfections.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 - 2. Lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

3.4 INSTALLATION OF COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat

3.5 PROTECTION

- A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 071113

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

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. Modified bituminous sheet waterproofing.
 - 2. Protection course.
- B. Related Requirements:
 - 1. Section 033000 "Cast-In-Place Concrete"
 - 2. Section 074650 "Fiber-Cement Wall Panels"
 - 3. Section 079200 "Joint Sealants"

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site.
 - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Samples: For each exposed product and for each color and texture specified, including the following products:
 - 1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.

1.5 QUALITY ASSURANCE

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

1.6 FIELD CONDITIONS

- A. **Environmental Limitations:** Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

- 1. Do not apply waterproofing in snow, rain, fog or mist.

- B. **Maintain adequate ventilation** during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

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

- B. **Installer's Special Warranty:** Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

- 1. Warranty includes removing and reinstalling protection board.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. **Source Limitations for Waterproofing System:** Obtain waterproofing materials and protection course, from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. **Modified Bituminous Sheet:** Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

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1. Products: Basis of Design: W.R. MEL-ROL as manufactured by W.R. Meadows, Inc. Subject to compliance with requirements, provide the named product or comparable products by one of the following:
 - a. Henry, A Carlisle Company.; CCW MiraDRI 860/861.
 - b. GCP Applied Technologies; Bituthene 3000 or Bituthene 4000
2. Physical Properties:
 - a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
 - e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
 - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
 - g. Water Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
3. Location: At foundations as indicated in drawings.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
- B. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction. Surface Conditioner: Liquid, waterborne or solvent based surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- C. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Detail Sealant: Elastomeric, single component, cold fluid applied, gun grade,
- G. Waterproofing Protection Course: 10 or 15 mil vapor barrier.

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 waterproofing.
 - 1. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. 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.
- E. Prepare, fill, prime and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane or detail sealant on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane or detail sealant in each direction from corner or install membrane strip centered over corner.
- G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply surface conditioner to substrates as directed by the waterproofing manufacturer.

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- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Seal edges of sheet-waterproofing terminations with mastic.
- F. Repair tears, voids and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.
- G. Immediately install protection course with butted joints over waterproofing membrane.

3.4 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

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. Extruded polystyrene foam-plastic board insulation.
 - 2. Glass-fiber blanket insulation.
 - 3. Mineral-wool blanket insulation.
 - 4. Drainage board.

- B. Related Requirements:

- 1. Section 061600 "Sheathing" for glass mat gypsum board sheathing installed directly over steel framing.
 - 2. Section 074114 "Standing Seam Metal Roof Panels" for insulation specified as part of standing seam metal roofing construction.
 - 3. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of membrane roofing construction.
 - 4. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Extruded polystyrene foam-plastic board insulation.
 - 2. Glass-fiber blanket insulation.
 - 3. Mineral-wool blanket insulation.
 - 4. Drainage Board

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to 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.

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- B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

- A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced.
1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 2. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.2 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.
 4. Location: At exterior walls
- B. Glass-Fiber Blanket Insulation, Foil Faced : ASTM C665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
1. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.
 2. Location: At basement exterior walls.

2.3 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
 - 3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.
 - 4. Location: At rated walls

2.4 DRAINAGE BOARD

- A. Geotextile-Faced, Wall-Insulation Drainage Board, Type VI: Extruded-polystyrene board insulation in accordance with ASTM C578, 40 psi (276 kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.6 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.
 - 1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.
 - 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042200 "Concrete Unit Masonry."
- B. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches (100 mm) from each corner of board insulation, at center of board, and as recommended by manufacturer.
 - 1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.7 INSTALLATION OF FOUNDATION DRAINAGE BOARD

- A. Place drainage board with geotextile faced side to exterior stone backfill.
- B. Install drainage board after vapor barrier has been applied and cured. Extend drainage board over footing and down edge of footing to below foundation drain.

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- C. Backfill with drainage stone as indicated on the drawings.

3.8 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. 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 072715 - NONBITUMINOUS SELF-ADHERING SHEET 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. Self-adhering, vapor-permeable, nonbituminous sheet air barriers.
- B. Related Requirements:
 - 1. Section 061516 "Wood Roof Decking" For Decking to be wrapped by waterproofing.
 - 2. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
 - 3. Section 072726 "Fluid-Applied Membrane Air Barrier" for Air Barrier to tie into at walls
 - 4. Section 076200 "Sheet Metal Flashing and Trim"

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 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

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1.5 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; 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- 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 air barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

1.7 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.

1.8 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.

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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 E2357.

2.3 NONBITUMINOUS SHEET AIR BARRIER

- A. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil- (0.5-mm-) thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.
 - 1. Products: Basis of Design: Air-Shield SMP as manufactured by W.R. Meadows, Inc. Subject to compliance with requirements, provide the named product or comparable products by one of the following:
 - a. Henry, A Carlisle Company.; Blueskin VP160.
 - b. GCP Applied Technologies; PAB VPS 30
 - 2. Physical and Performance Properties:

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- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
- b. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E154/E154M.
- c. Vapor Permeance: Minimum 15 perms (860 ng/Pa x s x sq. m; ASTM E96/E96M, Desiccant Method, Procedure A.
- d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541 as modified by ABAA.
- e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- f. UV Resistance: Can be exposed to sunlight for 50 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch (0.5 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.

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.

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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 membrane.
- 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, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
- B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic.
- C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.
- D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
 - 1. Apply sheets in a shingled manner to shed water.
 - 2. Roll sheets firmly to enhance adhesion to substrate.

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- E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.
- F. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- (150-mm-) wide, transition strip.
- G. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- H. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
 - 1. Coordinate air-barrier installation 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.
- I. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, and other construction used in exterior wall openings, using accessory materials.
- J. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- K. 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.
- L. 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 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.
- M. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- N. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- O. Do not cover air barrier until it has been tested and inspected by testing agency.
- P. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

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- Q. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air-barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed.
 7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
 8. Termination mastic has been applied on cut edges.
 9. Air barrier has been firmly adhered to substrate.
 10. Compatible materials have been used.
 11. Transitions at changes in direction and structural support at gaps have been provided.
 12. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 13. All penetrations have been sealed.
- R. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- S. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- T. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
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.

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- 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.

END OF SECTION 072715

SECTION 072726 – FLUID-APPLIED MEMBRANE AIR BARRIERS, VAPOR PERMEABLE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fluid-applied air and water barrier.

B. Related Requirements:

1. Section 042200 "Concrete Unit Masonry" for masonry substrate.
2. Section 076200 "Flashing and Sheet Metal"
3. Section 077000 "Roof and Wall Specialties and Accessories"
4. Section 061600 "Sheathing"
5. Section 074650 "Fiber-Cement Wall Panels"
6. Section 079200 "Joint sealants"
7. Section 081113 "Hollow Metal Doors and Frames"
8. Section 084113 "Aluminum-Framed Entrances and Storefronts"

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air barrier requirements including, but not limited to, the following:
 - a. Surface preparation specified in other Sections.
 - b. Minimum curing period.
 - c. Forecasted weather conditions.
 - d. Special details and sheet flashings.
 - e. Repairs.
 - f. Field quality control.

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 accessory materials 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 construction details, material descriptions and tested physical and performance properties of air barrier.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.
 - 3. Details shall be specific to the project. Generic Manufacturer details shall not be accepted.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air barrier manufacturer.
 - 1. Do not apply air barrier to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
 - 2. Do not apply air barrier in snow, rain, fog or mist or when such weather conditions are imminent during application and curing period.

1.8 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace air barrier that fails in materials or workmanship within specified warranty period.

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1. Warranty Period: Five years from date of Final Acceptance.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain air barrier materials from single source and from single manufacturer.

2.2 MANUFACTURERS

- A. Fluid-Applied Membrane Air Barrier, Vapor Permeable: Medium build, synthetic polymer type material with an installed dry film thickness of not less than 23 mils.
 1. Basis of Design: Air Shield LMP as manufactured by W.R. Meadows, Inc. Subject to compliance with requirements, provide the named product or comparable products by one of the following:
 - 1) Henry, a Carlisle Company.; Air-Bloc 17MR
 - 2) Prosoco, Inc; Spray Wrap MVP

2.3 LOCATION

- A. Provide Fluid-Applied Membrane Air Barriers at face of block and face of sheathing as indicated in drawings.

2.4 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa) when tested in accordance with ASTM E2357.
- B. Membrane Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa) pressure difference; ASTM E2178.
- C. Ultimate Elongation: Minimum 250 percent; ASTM D412. [vapor permeable]
- D. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested in accordance with ASTM D4541.
- E. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- F. Nail sealability: ASTM D 1970: Pass

- G. UV Exposure Limit: Equal to or greater than 180 calendar days.
- H. Water Vapor Permeance: ASTM E96, Method B: Minimum 10 perms.

2.5 ACCESSORY MATERIALS

- A. 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.
 - 1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.
 - 2. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.
 - 3. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
 - 4. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
 - 5. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
 - 6. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and non-corrosive substrate cleaner recommended by foam sealant manufacturer.
 - 7. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

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 concrete masonry has cured and aged for minimum time period recommended in writing by air barrierair barrier manufacturer.

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2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.
 3. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 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 PREPARATION

- A. Clean, prepare and treat substrates in accordance with manufacturer's written instructions. Provide clean, dust-free, and dry substrates for air barrier application.
- B. Mask off adjoining surfaces not receiving air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with air barrier manufacturer's written instructions and to recommendations. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.
 1. Comply with ASTM C1193 for joint-sealant installation.
 2. Apply bond breaker on sealant surface, beneath preparation strip.

3.4 FLUID-APPLIED MEMBRANE AIR BARRIER INSTALLATION

- A. Apply air barrier in accordance with manufacturer's written instructions.
- B. Start installing air barrier in presence of manufacturer's technical representative.
- C. Mix materials and apply air barrier by spray, roller, or other application method suitable to substrate.
 1. Apply one or more coats of air barrier material to obtain a seamless membrane free of entrapped gases and pinholes.
 2. Apply air barrier to prepared wall terminations and vertical surfaces.
- D. Cure air barrier, taking care to prevent contamination and damage during application and curing.

3.5 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- C. Connect and seal exterior wall air-barrier material continuously to concrete below-grade structures, exterior glazing and window systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. 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.
- F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, storefronts and doors. Apply modified bituminous transition strip or fluid applied flashing 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.
- G. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
- H. Fluid Applied Flashing: apply at manufacturer's recommended thickness.
- I. Fill gaps in perimeter frame surfaces of windows, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashing's or ending in reglets with termination mastic.
- K. 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.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a site representative qualified by air barrier membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection and drainage components and to furnish daily reports to Architect.

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- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air-barrier system has been provided.
 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 4. Site conditions for application temperature and dryness of substrates have been maintained.
 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 6. Surfaces have been primed, if applicable.
 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 8. Termination mastic has been applied on cut edges.
 9. Strips and transition strips have been firmly adhered to substrate.
 10. Compatible materials have been used.
 11. Transitions at changes in direction and structural support at gaps have been provided.
 12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 13. All penetrations have been sealed.
 14. Air barriers will be considered defective if they do not pass tests and inspections.
 15. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 16. Remove and replace deficient air-barrier components for retesting as specified above.
 17. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 PROTECTION

- A. Protect air barrier from damage and wear during remainder of construction period.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 90 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane 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. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates, reapply air barrier and repair sheet flashings.

END OF SECTION 072726

SECTION 074114 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Standing-seam metal roof panels.
2. Standing seam metal roofing accessories.
3. Metal Roofing edge metal and flashing
4. Underlayment materials
5. Warranty
6. Roof insulation.
7. Snow guards.

- B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 061516 "Wood Roof Decking" for roof decking.
3. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for roof edge flashings.
6. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
7. Section 263100 "Photovoltaic Collectors" for solar panels attached to roof.

1.3 PREINSTALLATION MEETINGS

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

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories, solar panels, and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

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3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
11. Review protection requirements for wood decking.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
2. Product Data: Submit product data, test reports, and certifications in accordance with quality assurance and performance requirements specified herein.
3. Design Loads: Submit manufacturer's minimum design load calculations according to ASCE 7, Method 2 for Components and Cladding. In no case shall the design loads be taken to be less than those specified herein.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
3. Fastening details and connections and interface with other products.
4. Details shall be specific to the project. Generic Manufacturer details shall not be accepted. Submitting the architectural roof details back to the architect as shop drawings shall not be accepted.

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

1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals. Provide manufacturer's maintenance instructions that include recommendations for periodic checking and maintenance of installed roof system.
- B. Provide executed copy of manufacturer's warranty.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work. Portable Roll-Forming equipment shall have precision leveling and an equal number of rollers as factory formed products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Unload, store and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimension of construction contiguous with metal roof panels by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- C. Coordinate Metal Panels with photovoltaic panel clips to ensure compatibility.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 30 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years, no dollar limit, from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Provide complete sheet metal roofing system, including, but not limited to, onsite, roll-formed metal roof panels, cleats, clips, anchors and fasteners, sheet metal flashing and drainage components related to sheet metal roofing, fascia panels, trim, underlayment, and accessories as indicated and as required for a weathertight installation.
- B. ASTM E 1592: Capacity shall be determined using pleated airbag method in accordance with ASTM E 1592, testing of sheet metal roof panels. Allowable safe working loads shall be determined by dividing the ultimate test load by the safety factor specified above.
- C. FM 4471: Submit test report for negative wind uplift pressures no less than that specified. Roof system must have approval over the substrate specified.
- D. Installed roof system shall be capable of resisting the following positive uniform roof loads: Roof Snow Load of 17 psf.
- E. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low-slope roof products.
- F. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- G. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- H. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
 - 2. 5 Gal. /Hr. per S.F. and Static No Leakage
 - 3. Pressure of 12.0 Psf for 15 minutes
- I. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- J. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.

K. Uniform Wind Load Capacity

1. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
 - a. Design Code: ASCE 7-16 ASD.
 - b. Safety Factor: 6 after any load reduction or material stress increase.
 - c. Category III Building.
 - d. Wind Speed: 115 mph.
 - e. Exposure Category: C.
 - f. Design Roof Height: 16 feet.
 - g. Minimum Building Width: 52 feet.
 - h. Roof Pitch: 1 inch per foot.
 - i. Roof Area Design Uplift Pressure:
 - 1) Zone 1 - Field of roof: 34 psf.
 - 2) Zone 2 - Eaves, ridges, hips, and rakes: 48 psf.
 - 3) Zone 3 – Corners: 75 psf.
 - 4) Zone 4 – Wall Perimeter: 32 psf
 - 5) Zone 5 – Wall Corner: 39 psf

L. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Design temperature differential shall be not less than 200 degrees F
3. Interface between panel and top rail/clip shall provide for unlimited thermal movement in each direction along the longitudinal direction.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation. Panels shall run from eave to ridge.

1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together with factory installed hot melt sealant in-seam cap. Panel/cap is configured with a total of 4 layers of metal surrounding anchor clip and top rail.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATAS International, Inc
 - b. Berridge Manufacturing Co.
 - c. Garland Company, Inc (The)
 - d. McElroy Metal.
 - e. Petersen Aluminum.
2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.040 inch (1.02 mm)].
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer.
 - d. Color: As selected by Architect from manufacturer's full range.
3. Clips: One-piece fixed or two-piece floating to accommodate thermal movement.
 - a. Material: 0.0625-inch- (1.587-mm-) thick, stainless steel sheet.
 - b. Clips must be extruded aluminum ONE (1) piece clip with projecting legs for additional panel alignment and provision for unlimited thermal movement in each direction along the longitudinal dimension.
 - c. Top Rail shall be snap-in-place extruded aluminum retainer. The top rail shall be used as a 6 inch length aligned with each panel clip, or in continuous lengths spanning one or more wind uplift zones, as required by the manufacturer's testing data and project engineering calculations.
 - d. Sealant applied in panel cap must be isolated from clip to ensure that no sealant damage occurs from the movement of the panel during expansion and contraction.
 - e. Clip must maintain a clearance of a minimum of 1/2 inch between panel and substrate for proper ventilation to help prevent condensation on underside of panel and eliminate the contact of panel fastener head to panel.
4. Panel Coverage: 16 inches (406 mm).
5. Panel Height: 2.0 inches (51 mm).
6. Panel Configuration: Pencil Ribs.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils (1.02 mm) thick, consisting of rubberized asphalt adhesive backed by a layer of slip-resistant coated high density cross laminated polyethylene film. Provide primer when recommended by underlayment manufacturer.
 1. Basis of Design: Grace Ice and Water Shield or equal, High Temperature, suitable for use under a metal roof.

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- B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by Standing Seam roof manufacturer.
- B. Thermal Insulation Properties and Approved Insulation Boards.

1. Flat Polyisocyanurate Roof Insulation; ASTM C-1289:

- a. Flat rigid closed cell polyisocyanurate foam core bonded to heavy duty glass fiber mat facers.
 - 1) Board Size: Four feet by four feet (4' x 4') or four by eight (4' x 8').
 - 2) Thickness: 1/8" : 12" Taper
 - 3) R-Value: Taper Average = R-30
 - 4) Compressive Strength: Minimum 20 psi
 - 5) Insulation board shall meet the following requirements: UL, WH or FM listed under Roofing Systems Federal Specification HH-I-1972, Class 1.
- b. Roof insulation shall not contain CFCs.

2.5 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 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.

2.6 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

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- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels. Factory precut closed cell foam meeting ASTM D 1056 or ASTM D 3575, enclosed in metal channel matching panels when used at hip, ridge, rake, and jamb.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters and Downspouts: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- E. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 - 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.
- G. Seam-Mounted Cast-Metal Snow Guards:
 - 1. Material:
 - a. ASTM B26/B26M cast aluminum; mill finish. 6005-T5 aircraft grade aluminum.
 - 2. Attachment: Manufacturer's tested mechanically fastened system, capable of resisting design loads.

2.7 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.8 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 - 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Structural Deck Substrate
 - 1. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped.
 - 2. Verify deck is dry and joints are solidly support and fastened.
 - 3. Certify wood nailers are installed and correctly located. Do not use pressure-treated wood containing salt-based preservatives or materials corrosive to steel.
- C. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the roof area indicated below:
 - a. Roof perimeter for a distance up from eaves of 36 inches (914 mm) beyond interior wall line.
 - b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (152 mm).
 - c. Rake edges for a distance of 18 inches (460 mm).
 - d. Hips and ridges for a distance on each side of 12 inches (305 mm).
 - e. Roof-to-wall intersections for a distance from wall of 18 inches (460 mm).
 - f. Around penetrating elements for a distance from element of 18 inches (460 mm).
- B. Felt Underlayment: Apply at locations indicated on Drawings, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).
 - 1. Apply over the entire roof surface.
 - 2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement. Install metal roof system in conformance with the NRCA Roofing and Waterproofing Manual, SMACNA

Architectural Sheet Metal Manual, Manufacturers approved shop drawings and installation requirements.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions. All anchor clips will be fastened into the structural roof substrates based on the manufacturer provided shop drawings and uplift calculations provided in the bid documents. Each substrate will require different spacing of clips for each zone. Fasteners shall not penetrate underside of wood decking.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Use gasketed fasteners where required to prevent corrosive action between fastener, substrate, and panels.
2. Install clips to supports with self-tapping fasteners.
3. Install pressure plates at locations indicated in manufacturer's written installation instructions.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Exposed fasteners, screws and/or roof mastic are unacceptable and will be rejected. System configuration only allows for exposed fasteners at panel overlap, if required, and at trim details in accordance with the Manufacturer's requirements.

6. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
- I. Snow Guards: Install at roof eaves over entrances, walkways and adjacent metal roof areas.
- J. Touch up exposed fasteners using paint furnished by roofing panel manufacturer and matching exposed panel surface finish. Touch up minor abrasion and scratches in finish.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Manufacturer Qualifications: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001 approval.
- C. Installer Qualifications: Certified and approved installer of the metal roofing manufacturer.
- D. If required, fabricator/installer shall submit work experience and evidence of adequate financial Responsibility. The Owner's representative reserves the right to inspect fabrication facilities in determining qualifications.
- E. Source Limitations: Obtain all components of the roof panel system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the Manufacturer.
- F. Upon request of the Architect/Engineer or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.
- G. Manufacturer shall have direct authority and control over all fabrication of steel components as well as the raw materials used in their fabrication.
- H. Engage the manufacturer's field representative to conduct required periodic inspections of work in progress as described herein and shall furnish written documentation of all such inspections. Keep the Architect/Owner informed as to the progress and quality of the work as observed.
- I. Manufacturer shall provide the Owner of the project with a written statement that they will provide a site inspection 3 days per week that confirms that the project is being constructed as specified, by an experienced, full-time employee of the company. Weekly photographic reports to be provided to the Architect or Owner.
- J. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- K. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- L. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074114

SECTION 074650 - FIBER-CEMENT WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. High-density fiber-cement wall panels.
 - 2. Cladding attachment system.
 - 3. UV Protective Membrane
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 071326 "Self-Adhering Sheet Waterproofing" for waterproofing.
 - 3. Section 072726 "Fluid Applied Membrane Air Barrier" for air barriers.
 - 4. Section 076200 "Sheet Metal Flashing and Trim" for Jamb closures

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting fiber cement shop drawings, examine procedures for ensuring quality of concrete masonry construction. Require representatives of each entity directly concerned with concrete masonry to attend, including the following:
 - a. Contractor's superintendent.
 - b. Installer.
 - c. Architect.
 - d. Masonry Supplier.
 - 2. Topics
 - a. Review shop drawing procedures and expectations

- b. Discuss coordination requirements

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles and finishes.
- B. Shop Drawings: Provide detailed drawings of non-standard applications of fiber cement materials which are outside the scope of the standard details and specifications provided by the manufacturer.
 - 1. Include elevations of layout, attachment details, penetration details, and trim details
- C. Attachment System Engineered Drawings:
 - 1. Provide engineered design for attachment and back-up framing to support exterior cladding.
 - 2. Provide static calculations verifying sizing of members, attachment devices and fasteners to support the exterior cladding with a safety factor required by Authority Having Jurisdiction (AHJ).
 - 3. Provide Installation drawings and details.
- D. Samples for Verification: For each type, color, texture and pattern required.
 - 1. 12-inch square Sample of panels.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.
- B. Color Evaluation: Insignificant change after 3000 hours of QUV test (EN 20105).
- C. Mock-Up: Provide a mock-up for evaluation of wall system, surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Mockup to include entire wall system including structure, waterproofing, insulation, window sills and jambs, cladding system, and wall panel pattern.
 - 3. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 4. Remodel mock-up area as required to produce acceptable work.

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1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover and in a dry location.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimal results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.
- B. Basis of Design: Fiber cement siding is based on products manufactured by Swisspearl Fiber Cement Panel supplied by American Fiber Cement Corp. Subject to compliance with requirements, provide the named products or comparable products along with all elements in the system by one of the following:
 - 1. Equitone.
 - 2. Reider Fiber C.

2.2 FIBER-CEMENT PANELS

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
- B. Product: Avera by Swisspearl supplied by American Fiber Cement Corp.

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1. Finish: Translucent matte surface coating showing a varied texture look.
2. Thickness: 8 mm (5/16").
3. Untrimmed Width: 1250 mm (49.2")
4. Untrimmed Lengths: 2510 mm (98.8"), 3050 mm (120.1")
5. Trimmed Width: 1219.2 mm (48")
6. Trimmed Lengths: 2438 mm (96"), 3045 mm (119.875")
7. Color: AV 060
8. Color: AV 100
9. Physical Characteristics: ASTM C1185/C1186, EN 12467 'Fiber Cement Flat Sheets'
 - a. Durability classification: Category A.
 - b. Strength classification: Class 4.
 - c. Freeze thaw test: greater than 100 cycles.
10. Fire Testing:
 - a. ASTM E84.
 - b. ASTM E136.
 - c. CAN/ULC S102.
 - d. CAN/ULC S114.
 - e. EN 13501-1: A2-s1-d0.
11. Light Fastness (ASTM G155-05): Comply
12. For additional test data, see product datasheet.

C. Pattern: Custom cut, as indicated.

2.3 Miscellaneous Cladding Materials

A. Water-resistive Barrier for Walls: Vapor permeable water-resistive barrier with tear-resistant thermo-bonded, non-woven polyester substrate and waterproof acrylic polymeric coating stabilized against oxidation and UV degradation.

1. Product: Delta – Fassade S by Dorken Systems Inc, or approved equal.
2. Service Life Expectancy: > 25 years.
3. Weight: 5.5 lb/100 ft², 270 g/m², 44 lb/roll nominal.
4. Roll Dimensions: 4' 11" x 164'.
5. Color: Black
6. Maximum Exposed Area: Open joints to a maximum of 50 mm (2 inches) constituting no more than 50% of overall façade area

2.4 Attachment Systems

A. Attachment System, XKELEX Z19:

1. Product: Perforated horizontal Aluminum profiles supplied by Fiber Cement Manufacturer
 - a. Material: 6063-T5
 - b. Finish – Black Powder Coat

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2.5 FIXING ACCESSORIES FOR ATTACHEMENT SYSTEMS

- A. Rivets: color-matched stainless-steel Astro rivets (for use with metal supporting members).
 - 1. Supplied by Fiber Cement Manufacturer.

2.6 Accessories

- A. Corner Trim
 - 1. Basis of Design: Corner Trim is based on products manufactured by XOCR516 as manufactured by R.H. Tamlyn and Sons, LP. Subject to compliance with requirements, provide the named products or comparable products along with all elements in the system by one of the following:
 - a. Fry Reglet
 - b. Nakamoto Forestry
 - 2. Material : 6065 T5 Extruded Aluminum
 - 3. Size: As required for panel system.
 - 4. Finish: Urbane Bronze to match roof
 - 5. Profile: As shown in drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement panels and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prepare surfaces using the method recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals.
- B. Comply with requirements of authorities having jurisdiction and with manufacturers' recommendations for fastener spacing.

3.4 EXTERIOR CLADDING FOR RAINSCREEN APPLICATIONS

A. Detailing Requirements:

1. Air space at top and bottom of building or wall termination shall be 3/4 inch (20 mm) to facilitate airflow from behind the panels. Do not block vertical airflow at windows, doors, eaves, or at the base of the building. Airflow shall be continuous from bottom to top so there is air movement behind each panel. For walls over 60 feet high (18 m), the ventilated cavity between rear of panels and exterior wall shall be increased to 1-5/8 inches (40 mm). Air flow behind the cement fiber panels is critical to the performance of the rain screen constructions.
2. Fasteners in profile shall accommodate thermal expansion/contraction of metal and not interfere with panel application.
3. Install panels from top of building to bottom.
4. For straight walls, start panel installation in center and work outward.
5. For walls with inside corners, start installation at corner and work across wall.

B. Rain Screen Installation: Comply with manufacturer's installation requirements.

1. Attachment System: comply with manufacturer's engineered design for cladding support framing.

3.5 PROTECTION

- #### A. Protect installed products until completion of project.
- #### B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION 074650

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) 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. Adhered polyvinyl chloride (PVC) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Vapor retarder.
5. Roof insulation.
6. Insulation accessories and cover board.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 061516 "Wood Roof Decking" for Roof Deck.
3. Section 074114 "Standing Seam Metal Roof Panels" for standing seam roofing.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for roof edge flashings.
6. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in 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 roof deck construction, conduct conference at Project site.
 1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system

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manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories.

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. Review deck substrate requirements for conditions and finishes, 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.

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

1. Meet with Owner, Architect, Construction Manager, 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 SPRI's Directory of Roof Assemblies listing.

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- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Layout and thickness of insulation.
 - 2. Base flashings and membrane terminations.
 - 3. Flashing details at penetrations.
 - 4. Tapered insulation thickness and slopes.
 - 5. Roof plan showing orientation of wood roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
 - 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 - 7. Tie-in with air barrier.
- C. Samples for Verification: For the following products:
 - 1. Roof membrane and flashing, of color required.
- 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 compliance with performance requirements.
 - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field Test Reports:
 - 1. 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.

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1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

- A. Qualifications:

1. Manufacturers: A qualified manufacturer that is listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.
2. Installers: 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. Protect stored liquid material from direct sunlight.
 1. 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. Store in a dry location. 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.

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1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.
 2. Warranty Period: 20 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, substrate boards, and vapor retarders for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, calculated in accordance with the most current revision of ASCE 7, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.
1. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials to 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): 34 psf
 2. Zone 2 (Roof Area Perimeter): 48 psf
 3. Zone 3 (Roof Area Corners): 75 psf
 - a. Location: 12 feet in each direction from building corner.
- D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
1. Wind Uplift Load Capacity: 105 psf.

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- E. ENERGY STAR Listing: Roofing system to be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

- A. PVC Sheet Type III, Fabric Backed: ASTM D4434/D4434M, fabric reinforced and fabric backed.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Carlisle Syntec Systems
 - b. Elevate
 - c. GAF Materials Corporation
 - d. Garland Roofing Inc
 - e. Johns Manville

- 2. Membrane Thickness: 60 mils (1.5 mm).

- 3. Exposed Face Color: White.

- B. PVC Keytone Ethylene Ester (KEE) Sheet, Fabric Backed: ASTM D4434/D4434M, Type III, with fabric backing.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Carlisle Syntec Systems
 - b. Elevate
 - c. GAF Materials Corporation
 - d. Garland Roofing Inc
 - e. Johns Manville

- 2. Membrane Thickness: 60 mils (1.50 mm).

- 3. Exposed Face Color: White.

- C. Source Limitations: Obtain components for roofing system from manufacturers approved by roof membrane manufacturer.

2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

- D. Bonding Adhesive: Manufacturer's standard, water based.

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- E. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- F. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARD

- A. Plywood.
 - 1. Thickness: As shown on structural drawings.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer approved for use in SPRI's Directory of Roof Assemblies listed roof assemblies.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Compressive Strength: 20 psi (138 kPa).
 - 2. Size: 48 by 48 inches (1219 by 1219 mm).
 - 3. R-value: Taper Average = R-30

2.6 INSULATION ACCESSORIES AND COVER BOARD

- 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. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

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- D. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, water-resistant gypsum board.

- 1. Thickness: 1/2 inch (13 mm).

2.7 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.

- 1. Basis of Design: Self-adhering sheet underlayment is based on Ice and Water Shield, as manufactured by W.R. Grace & Co. Subject to compliance with requirements, provide the named product or comparable product by one of the following:

- a. Johns Manville.
 - b. Owens Corning

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 blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- 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 system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 - 1. Submit test result within 24 hours of performing tests.

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- a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.
 1. Tightly butt substrate boards together.
 2. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.

3.5 INSTALLATION OF VAPOR RETARDER

- A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 and 6 inches (50 and 150 mm), respectively.
 1. Extend vertically up parapet walls and projections to a minimum height equal to height of the insulation and cover board.
 2. Continuously seal side and end laps with adhesive.
- B. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches (90 and 150 mm), respectively.
 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
 2. Seal laps by rolling.

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- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.
 - 1. Eaves: Extend from edges of eaves 36 inches (914 mm) beyond interior face of exterior wall.
 - 2. Rakes: Extend from edges of rake 36 inches (914 mm) beyond interior face of exterior wall.
 - 3. Valleys: Extend from lowest to highest point 18 inches (450 mm) on each side.
 - 4. Hips: Extend 18 inches (450 mm) on each side.
 - 5. Ridges: Extend 36 inches (914 mm) on each side without obstructing continuous ridge vent.
 - 6. Sidewalls: Extend beyond sidewall 18 inches (450 mm) and return vertically against sidewall not less than 4 inches (100 mm).
 - 7. Roof Slope Transitions: Extend 18 inches (450 mm) on each roof slope.

3.7 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Wood Decking:
 - 1. Fasten slip sheet according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - 2. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 3. Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - 4. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 5. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.

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- a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
- b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
- c. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- d. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- e. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, 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.

3.8 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 2. Cut and fit cover board tight to nailers, projections, and penetrations.
 3. Adhere cover board to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - b. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- B. Install slip sheet over cover board and immediately beneath roof membrane.

3.9 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.

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- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel Owner's testing and inspection agency.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Any wrinkles or buckles must be removed from the sheet prior to permanent attachment. Roof membrane shall be fully adhered immediately after it is rolled out, followed by welding to adjacent sheets.
- E. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations and perimeter of roofing.
- F. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- I. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- J. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

3.10 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

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3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection and drainage components, and to furnish reports to Architect.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: **<Insert name of Owner>**.
 - 2. Owner Address: **<Insert address>**.
 - 3. Building Name/Type: **<Insert information>**.
 - 4. Building Address: **<Insert address>**.
 - 5. Area of Work: **<Insert information>**.
 - 6. Acceptance Date: _____.
 - 7. Warranty Period: **<Insert time>**.
 - 8. Expiration Date: _____.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

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- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding <Insert mph (m/s)>;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

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7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075419

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall flashing sheet metal fabrications.
2. Door and window jambs at fiber cement panels.
3. Miscellaneous sheet metal fabrications.

B. Related Requirements:

1. Section 042200 "Concrete Unit Masonry" for flashing masonry walls
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 077100 "Roof Specialties" for roof-edge specialties and drainage systems.
4. Section 081113 "Hollow Metal Doors and Frames" for exterior door frames.
5. Section 084113 "Aluminum-Framed Entrances and Storefronts" for exterior windows.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

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1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of special conditions.
9. Include details of connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long by actual width.

1. Sheet Metal Flashing: 12 inches (300 mm) 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 (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.7 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.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Color: As selected by Architect from manufacturer's full range, unless otherwise noted.
 - 1) Flashing at storefront to be custom color to match storefront.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.
 - 1. Source Limitations: Obtain underlayment from single source from single manufacturer.
- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal.
- 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.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Solder:
 - 1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

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- E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, polysulfide or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- I. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- J. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Source Limitations: Obtain reglets from single source from single manufacturer.
 - 2. Material: Stainless steel, 0.0188 inch (0.477 mm) 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. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - 5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 6. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 - 7. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

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1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
1. Aluminum: 0.032 inch (0.81 mm) thick.
 2. Stainless Steel: 0.0156 inch (0.396 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate 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.
 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
1. Install in shingle fashion to shed water.
 2. Lap joints not less than 4 inches (101 mm).
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
1. Lap horizontal joints not less than 4 inches (101 mm).
 2. Lap end joints not less than 12 inches (300 mm).
- C. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
1. Install in shingle fashion to shed water.
 2. Lapp joints not less than 4 inches (101 mm).

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
 - 6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 8. Do not field cut sheet metal flashing and trim by torch.
 - 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 - 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
 - 1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
 - 2. Do not solder metallic-coated steel and aluminum sheet.
 - 3. Do not pretin zinc-tin alloy-coated copper.
 - 4. Do not use torches for soldering.
 - 5. Heat surfaces to receive solder and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 - 6. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.5 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof-edge specialties.
2. Roof-edge drainage systems.
3. Reglets and counterflashings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 074114 "Standing-Seam Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
4. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
5. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
6. Sitework for downspout connections.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.2 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, sections, and attachment details.

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2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples: For each type of roof specialty and for each color and texture specified.

D. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For roof-edge flashings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

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1. Build mockup of typical roof edge, including fascia, gutter, and downspout, approximately 10 feet (3.0 m) long, including supporting construction, seams, attachments, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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. Roofing-System Warranty: Roof specialties are included in warranty provisions in Sections 074114 "Standing Seam Metal Roof Panels" and 075423 "Thermoplastic-Polyolefin (TPO) Roofing."
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 074114 Standing Seam Metal Roof Panels and 075423 Thermoplastic-Polyolefin (TPO) Roofing.
 - 1. Obtain Aluminum Gutters and Standing Seam Roof Edge Systems approved by Standing Seam Metal Roof Manufacturer.
 - 2. Obtain Roof Edge Systems for TPO Roof approved by TPO Roof manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties to 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. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
 - 1. Design Pressure: As indicated on Structural Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 ROOF-EDGE SPECIALTIES

- A. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet (3.6 m), with a horizontal flange and vertical leg fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.
 - 1. Formed Aluminum Sheet Gravel Stops: Aluminum sheet, thickness as required to meet performance requirements.
 - a. Surface: Smooth, flat finish.
 - b. Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.

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. Materials:
 - a. Aluminum Sheet: 0.040 inch thick.
 - b. Weathering Steel: 22 gauge ASTM A606-4
 - 2. Gutter Profile: As indicated in drawings.
 - 3. Gutter Supports: Gutter brackets, Straps, Manufacturer's standard supports as selected by Architect with finish matching the gutters.
- B. Aluminum 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: 0.032 inch (0.81 mm) thick.
- C. Weathering Steel Downspouts: Open-face rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
 - 1. Weathering Steel: 22 Gauge ASTM A606-4
- D. Aluminum Finish: Two-coat fluoropolymer.
 - 1. Color: Custom Color to match structure.
- E. Weather Steel Finish: Unfished natural weathering

2.5 REGLETS AND COUNTERFLASHINGS

- A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
 - 1. Stainless Steel: .0188 inch (0.477 mm) thick.
 - 2. Corners: Factory mitered and continuously welded.
 - 3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 4. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - 5. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

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- B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
 - 1. Formed Aluminum: 0.032 inch (0.81 mm) thick.
- C. Accessories:
 - 1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
 - 2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- D. Aluminum Finish: Two-coat fluoropolymer
 - 1. Color: as selected by architect from manufacturer's full range
- E. Stainless Steel Finish: Manufacturer's standard color coating.

2.6 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. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:
- C. Steel Sheet: ASTM A606 High Strength Low Alloy Weathering Steel.

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.
 - 3. Fasteners for Weathering Steel: Aluminum or Series 300 Stainless steel
- B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

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- 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 polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 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).
- E. Aluminum Extrusion 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 polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. 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 INSTALLATION, GENERAL

- A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
 - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 - 4. Torch cutting of roof specialties is not permitted.
 - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
 - 1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
 - 2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

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- D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- 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).

3.3 INSTALLATION OF ROOF-EDGE SPECIALITIES

- 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.

3.4 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

- A. 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 30 inches (762 mm) apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
 - 1. Join sections with riveted and soldered joints.
 - 2. Provide for thermal expansion.
 - 3. Attach gutters at eave or fascia to firmly anchor them in position.
 - 4. Provide end closures and seal watertight with sealant.
 - 5. Slope to downspouts.
 - 6. Fasten gutter spacers to front and back of gutter.
 - 7. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
 - 8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart
 - 9. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.
- C. Aluminum 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.

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- D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

3.5 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See Section 033000 "Cast-in-Place Concrete" and Section 042000 "Unit Masonry" for installation of reglets.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.6 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 078100 - APPLIED FIRE PROTECTION

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. Sprayed fire-resistive materials.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for framing to receive fireproofing.
 - 2. Section 053100 "Steel Decking" for decking to receive fireproofing.

1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Sprayed fire-resistive material.
 - 2. Substrate primers.
 - 3. Bonding agent.
 - 4. Metal lath.
 - 5. Reinforcing fabric.
 - 6. Reinforcing mesh.
 - 7. Sealer.
 - 8. Topcoat.

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- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 - 1. Extent of fire protection for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of sprayed fire-resistive material after application.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of sprayed fire-resistive material.
- C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.
- D. Preconstruction Test Reports: For fire protection.
- E. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
 - 1. Build mockup of each type of fire protection and different substrate as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups of fire protection.
 - 1. Field Mockup: 4' square including both deck and beam.
 - 2. Provide test specimens and assemblies representative of proposed materials and construction.

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- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
 - 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 2. Density: Test for density according to ASTM E605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with sprayed fire-resistive material.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, obtain sprayed fire-resistive material manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F (7 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fire protection, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fire protection from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

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2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. Sprayed Fire-Resistive Material UL D859: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
1. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Bond Strength: Minimum 150-lbf/sq. ft. (7.18-kPa) cohesive and adhesive strength based on field testing according to ASTM E736.
 3. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E605.
 4. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch (9 mm).
 5. Combustion Characteristics: ASTM E136.
 6. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 10 or less.
 7. Compressive Strength: Minimum 10 lbf/sq. in. (68.9 kPa) according to ASTM E761.
 8. Corrosion Resistance: No evidence of corrosion according to ASTM E937.
 9. Deflection: No cracking, spalling, or delamination according to ASTM E759.
 10. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E760.
 11. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E859.
 12. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21.
 13. Finish: As selected by Architect from manufacturer's standard finishes.
 - a. Color: As indicated by manufacturer's designations.

2.3 AUXILIARY MATERIALS

- A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:
1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

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2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.
- C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and sprayed fire-resistive material manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.
- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by sprayed fire-resistive material manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.
- G. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.
- H. Topcoat: Suitable for application over sprayed fire-resistive material; of type recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.
 1. Cement-Based Topcoat: Factory-mixed, cementitious hard-coat formulation for trowel or spray application over SFRM.
 2. Water-Based Permeable Topcoat: Factory-mixed formulation for brush, roller, or spray application over applied SFRM. Provide application at a rate as recommended by manufacturer for full coverage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.
 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and

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- encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
 - 2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.
- B. Verify that concrete work on steel deck is complete before beginning Work.
 - C. Conduct tests according to sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
 - D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.
- B. Clean substrates of substances that could impair bond of fire protection.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.
- B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.

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1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
- D. Metal Decks:
1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
 2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.
- F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
- G. Extend fire protection in full thickness over entire area of each substrate to be protected.
- H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.
- I. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.
- J. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.
- K. Cure fire protection according to sprayed fire-resistive material manufacturer's written instructions.
- L. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.
- M. Finishes: Where indicated, apply fire protection to produce the following finishes:
1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
 3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
 4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.

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3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect , as indicated on Schedule of Special Inspections.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fire protection will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fire protection that does not pass tests and inspections, and retest.
 - 2. Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

- A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

- A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.
- B. Repair fire protection damaged by other work before concealing it with other construction.
- C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Mildew-resistant joint sealants.

B. Related Sections

1. 079219 "Acoustical Joint Sealants" for joint sealants in acoustical applications.
2. 088000 "Glazing" for joint sealants at glazing.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

A. Product Data:

1. Joint sealants.
2. Joint-sealant backing materials.

- B. Samples for Verification: For each type 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.

C. 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 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with 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: Twenty 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 causing 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 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Dowsil
- 2. Momentive
- 3. Pecora

2.3 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.

2.4 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
- B. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade P, Class 100/50, Uses T and NT.

2.5 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
- C. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

2.6 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

2.7 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.8 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.

2.9 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.
 - d. Exterior insulation and finish systems.
 - 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. Porcelain enamel.
 - d. 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 type 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 in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

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

B. Tests and Inspections:

1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform one test for each 1000 ft. (300 m) of joint length thereafter or one test per each floor per elevation.
 - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.
 - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

3.5 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.

3.6 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.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
 - 1. Joint Locations:
 - a. Joints between exterior concrete and building.
 - 2. Silicone Joint Sealant: Immersible, multicomponent, non-sag, traffic grade.
 - 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. Control and expansion joints in unit masonry.
 - b. Perimeter joints between materials frames of doors, windows and louvers.
 - 2. Silicone Joint Sealant: Single component, non-sag, neutral curing, Class 100/50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in tile flooring.
 - 2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
 - 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.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.

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- c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - 2. Silicone Joint Sealant: Mildew resistant, single component, non-sag, neutral curing.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors and counters.
 - 2. Silicone Joint Sealant: Mildew resistant, single component, non-sag, neutral curing.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Masonry Walls
- 1. Joint Sealant Location:
 - a. Expansion and control joints in masonry walls.
 - 2. Urethane Joint Sealant: Mildew resistant, single component, non-sag, neutral curing.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

3.8 WASTE MANAGEMENT

- A. Separate corrugated cardboard and place in designated areas for recycling.
- B. Place materials defined as hazardous or toxic waste in designated containers.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for joint sealants for non-acoustical applications.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Acoustical joint sealants.
- B. Samples for Verification: For each type and color of acoustical joint sealant required.
 - 1. Size: 1/2-inch- (13-mm-) wide sealant joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Acoustical Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
 - 1. Manufacturers' special warranties.
 - 2. Installer's special warranties.

1.4 WARRANTY

- A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

- A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 1. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- 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 acoustical 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 acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. 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 ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

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 acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical 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 acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Exterior hollow-metal window frames.

B. Related Requirements:

1. Section 081416 "Flush Wood Doors" for Wood doors installed in Hollow Metal Frames
2. Section 081613 "Fiberglass Reinforced Plastic Doors" for FRP doors in Hollow Metal Frames
3. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
4. Section 088000 "Glazing" for glass view panels in hollow metal doors

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 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.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

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

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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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.

- B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

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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 doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) 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. Curries Company; an Assa Abloy Group Company.
 2. Republic Doors and Frames.
 3. Steelcraft; an Ingersoll-Rand Company.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: 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 in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra Heavy-Duty Doors and Frames: ANSI/SDI-100, Grade III, Model 4.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches (44.5 mm).
- c. Face: Metallic-coated steel sheet, minimum 16-gauge thickness.
- d. Edge Construction: Model 2, Seamless.
- e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
- f. Core: Manufacturer's standard.
- g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated doors.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum 14-gauge thickness.
- b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
- c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL WINDOWS, DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra Heavy-Duty Doors and Frames: ANSI/SDI-100, Grade III, Model 4.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches (44.5 mm).
- c. Face: Metallic-coated steel sheet, minimum 16-gauge thickness, with minimum A60 (ZF180) coating.
- d. Edge Construction: Model 2, Seamless.
- e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
- f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
- g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- h. Core: Manufacturer's standard.
- i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation or laminated mineral board core for fire-rated doors.

2. Frames:

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- a. Materials: Metallic-coated steel sheet, minimum 14-gauge thickness, with minimum A60 (ZF180) coating.
 - b. Construction: Full profile welded.
3. Exposed Finish: Prime.

2.5 BORROWED LITES

- A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
- B. Construction: Full profile welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement,

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mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for frames to receive flush wood doors.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Factory-machining criteria.
6. Factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

9. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. Submit 3 samples showing complete range of variation in finish.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranties.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.
- C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies complies with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions. Doors shall not be delivered until a weatherproof storage space is available.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations:

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1. Do not deliver, store or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm) span.
2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Forte Opening Solutions.
 2. Lambton Hardwoods, Inc..
 3. VT Industries, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Provide labels or certificates from AWI certification program indicating that doors comply with requirements of grades specified.
 - a. Contractor registers the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.
 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:
1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
 2. Architectural Woodwork Standards Grade: Premium.
 3. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.
 - a. Species: Select white maple.
 - b. Cut: Plain sliced (flat sliced).
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: Balance match.
 - e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - f. Room Match:
 - 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet (3 m) or more.
 - 2) Provide door faces of compatible color and grain within each separate room or area of building.
 4. Exposed Vertical Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors:
 - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

- 2) Provide formed-steel edges and astragals with intumescent seals.
 - a) Finish steel edges and astragals to match door hardware (locksets or exit devices).
- c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 475 lbf (2110 N) in accordance with WDMA T.M. 10.
5. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-1 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Door Face: 475 lbf (2110 N).
 - 2) Screw Withdrawal, Vertical Door Edge: 475 lbf (2110 N).
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
6. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
 - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard shape.

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3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
 3. Louvers: Factory install louvers in prepared openings.

2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.

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3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
 1. Staining: As selected by Architect from manufacturer's full range.
 2. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
 3. Install fire-rated doors and frames in accordance with NFPA 80.
 4. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

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- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 081613 – FIBERGLASS REINFORCED DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fiberglass reinforced plastic (FRP) doors

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for frames to receive FRP doors.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Factory-machining criteria.
6. Factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Doors to be factory finished and application requirements.

C. Samples for Verification:

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1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. Submit 3 samples showing complete range of variation in finish.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranties.
- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 20 years documented experience and with a record of successful in-service performance for the applications as required for this project.
- B. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.
- C. Source Limitations: Obtain fiberglass reinforced plastic doors and stainless steel frames through one source fabricated from a single manufacturer.
- D. Source Limitations: Hardware and accessories for all FRP doors as specified in Section 08710 should be provided and installed by the fiberglass door and frame manufacturer.
- E. Source Limitations: Glass for windows in doors shall be furnished and installed by door and frame manufacturer in accordance with related section, Division 8, Glazing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions. Doors shall not be delivered until a weatherproof storage space is available.
- B. Store door assemblies in manufacturer's standard containers, on end, to prevent damage to face, corners and edges.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

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1. Failures include, but are not limited to, the following:
 - a. Delamination of fiberglass.
 - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 - d. Failure due to corrosion from specified environment.
2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Fiberglass Reinforced Panel Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain FRP doors from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cline Doors
 2. Corrim Company
 3. Special-Lite
 4. Weiland Industrial Doors and Windows

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-rated door, panel and frame construction conforms to products tested under ASTM E152, UL10C & NFPA 252.
- B. Install doors, panels and frames conforming to NFPA 80 for fire-rated class, ANSI A117.1 specifications for handicap accessibility, ADA requirements, ANSI A250.4-2011 cycle swing in excess of 1,000,000 cycles with no failure of any design features of the door.
- C. Flame Spread: All rated FRP component parts, including the finish, shall have a flame spread classification of 25 or less per ASTM E84 and shall be self extinguishing per ASTM D635, unless operating conditions dictate otherwise.

2.3 FIBERGLASS REINFORCED DOORS

- A. Faces:
 1. Material: Fiberglass Reinforced Panels

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- a. FRP face sheets shall be manufactured using a corrosion resistant resin system with light stabilizing additives. The resin shall be reinforced with fiberglass, 50% average by weight for enhanced strength.
2. Provide completely seamless construction on all 6 surfaces
3. Thickness: 1/8" Minimum
4. Finish Texture: Smooth
5. Finish Color: As selected by the architect from manufacturer's full range

B. Stiles and Rails:

1. Material: 1-1/2 inch square pultruded fiberglass tubes.
2. Reinforcement:
 - a. Non-rated and 20 minute doors will have a full width horizontal 1-1/2 inch square pultruded fiberglass tube every 24 inches in height for internal reinforcement.
3. A minimum of 1,000 pounds screw withdrawal force shall be required per screw.
4. The bottom rail shall allow for 1-1/4 inches of height alterability without loss of the panel's integrity.
5. No metal or wood reinforcements will be permitted.
6. Core:
 - a. Polyurethane Foam Core:
 - 1) 1-1/2 inch thick rigid block of polyurethane laminated to the interior of the panels.
 - 2) The polyurethane insulation shall be Class A and CFC free.
 - 3) Foam properties comply with ASTM E-84 and The International Building Code (IBC).

7. E. Hardware Preparations:

- a. Doors shall be reinforced and mortised for hardware with 1-1/2 inches x 1-1/2 inches of solid fiberglass to allow application of hinges and locks, in accordance with the hardware schedule, hardware manufacturer's instructions and templates.
 - 1) Reinforcement Blocking: Non-swelling polymer or firestop blocking will be used for all lockset, surface mounted hardware and through bolted hardware blocking.
 - 2) Pilot holes for full mortise butt hinges will be pre-drilled by factory.
 - 3) All hardware shall be attached/installed by using pilot hole and stainless steel wood screws.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.

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1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

2.5 FACTORY FINISHING

A. Polyurethane finish, high solids polyurethane topcoat that exhibits excellent chemical resistance, outstanding toughness, flexibility, abrasion resistance and excellent outside durability.

1. Semi-Gloss; all face sheet options.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
 2. Anchor frames to anchors or blocking built in or directly attached to substrates.

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- a. Secure with countersunk, concealed fasteners and blind nailing.
- b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
- 3. Install fire-rated doors and frames in accordance with NFPA 80.
- 4. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

3.4 Cleaning

- A. Remove dirt and excess sealant from exposed surfaces
- B. Follow manufacturer's recommended cleaning techniques and procedures for cleaning all surfaces.
- C. Do not use cleaning products that will scratch or damage surfaces.

END OF SECTION 081613

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.
2. Fire-rated access doors and frames.

B. Related Requirements:

1. Section 09 9600 "High Performance Coatings" for finish painting of factory-primed doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies meets the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
2. Larsen's Manufacturing Company.
3. Nystrom, Inc.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:

1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and continuous piano hinge, set to open 175-degrees.
2. Locations: Wall and ceiling.
3. Door Size: 24"x24".
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 14 gauge factory finished.
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Cam latch, screwdriver operated.
7. Finish: Factory primed per 099600

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

- A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
2. Locations: Wall and ceiling.
3. Door Size: As indicated.
4. Fire-Resistance Rating: Not less than that of adjacent construction.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gauge, factory finished.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-closing, self-latching door hardware, operated by key.
8. Finish: Factory primed per 099600.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

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- 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.

2.5 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.
- D. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Per section 099600 "High Performance Coatings"
 - 2. Field Finished: Paint per section 099600 "High Performance Coatings". Color to match adjacent wall or ceiling.

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.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

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

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated galvanized steel service doors.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
2. Section 076200 "Sheet Metal Flashing and Trim" for flashing at overhead doors.
3. Section 09 9600 "High Performance Coatings" for finish painting of factory-primed doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats and finishes.
2. Include rated capacities, operating characteristics and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections and mounting details.
2. Include details of equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices and other accessories.

C. Samples: Color chip in manufacturer's standard size of custom finish color.

1.3 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Raynor Garage Doors.
 - 2. Cornell Cookson.
 - 3. Overhead Garage Door.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 3. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. (960-Pa) wind load, acting inward and outward.
- C. Windborne-Debris Impact Resistance: Provide overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1 for basic protection.

2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking galvanized steel slats.
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283.
- D. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W).
- E. Insulated Door Assembly U-Factor: 0.90 Btu/deg F x h x sq. ft. (5.1 W/K x sq. m).
- F. Door Curtain Material: Galvanized steel.
- G. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) to 3-1/4-inch (83-mm) center-to-center height.
 - 1. Insulated-Slat Interior Facing: Galvanized steel.
- H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8-inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- I. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- J. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- K. Locking Device: Equip door with slide bolt.
- L. Manual Door Operator: Chain hoist operation.
- M. Curtain Accessories: Equip door with weatherseals and push-pull handles.
- N. Door Finish:
 - 1. Steel Finish: Baked enamel or powder coated Finish:
 - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

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1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A653/A653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.28 inch (0.71 mm), and as required.
 2. Insulation: Fill slats for insulated doors with manufacturer's standard CFC-free thermal insulation.
 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain and a continuous bar for holding windlocks.

2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: 0.028-inch- (0.71-mm-) thick hot-dip galvanized steel sheet with G90 (Z275) zinc coating complying with ASTM A653/A653M.

2.6 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolt to engage through slot in track.

2.7 CURTAIN ACCESSORIES

- A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation.
1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm) thick seals of flexible vinyl, rubber, or neoprene.
- B. Push/Pull Handles: Equip emergency-operated door with lifting handles on each side of door, finished to match door.

2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and

contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual chain hoist

2.10 GENERAL FINISH REQUIREMENTS

- A. 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.

2.11 STEEL AND GALVANIZED STEEL FINISHES

- A. Baked Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application and minimum dry film thickness.
- B. Finish Color: Color as selected by the Architect from the manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls and operators at the mounting locations indicated for each door.

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- C. Accessibility: Install overhead coiling doors, switches and controls along accessible routes in compliance with the accessibility standard.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test manual operation of closed door.
 - 2. Repair, remove and replace installations where inspections indicate that they do not comply with specified requirements.
 - 3. Reinspect repaired or replaced installations to determine if repaired or replaced door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain overhead coiling door.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Aluminum-framed storefront systems.
 - 2. Aluminum-framed entrance door systems.
- B. Related Sections:
 - 1. Section 042200 "Concrete Unit Masonry" for construction to receive storefront systems.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for Storefront flashing and trim
 - 3. Section 088000 "Glazing" for glass materials to be incorporated into storefronts.
 - 4. Section 088100 "Door Hardware" for door hardware.

1.3 PREINSTALLATION MEETINGS

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

1.4 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 aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.

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- c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
- 3. Show connection to and continuity with adjacent thermal, weather, air and vapor barriers.
- 4. Include point-to-point wiring diagrams showing the following:
 - a. Electrified hardware and card access.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: An entity that employs installers and supervisors who are trained and approved by the manufacturer.
 - 2. Egress Door Inspector: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 - a. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

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- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO
2. Kawneer North America.
3. Oldcastle Building Envelope
4. Tubelite, Inc.
5. YKK AP America, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Structural Loads:
1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
- C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
- D. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

- E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
 - 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
 - 1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F (4.37 W/sq. m x K) as determined in accordance with NFRC 100.
 - 2. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283.
 - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - 3. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 70 as determined in accordance with AAMA 1503.
 - b. Entrance Doors: CRF of not less than 63 as determined in accordance with AAMA 1503.
- H. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

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1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.3 STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Exterior Framing Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
 4. Finish: High-performance organic finish.
 5. Fabrication Method: Field-fabricated stick system. Horizontal members to be mitered at angled elevations.
 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 7. Steel Reinforcement: As required by manufacturer. Reinforcing shall be included to eliminate thru-bolts.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
 1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: As indicated.

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3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware for each entrance door to comply with requirements in Section 087100 "Door Hardware."
- B. Weather Stripping: Manufacturer's standard replaceable components.
 1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
- C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.6 GLAZING

- A. Glazing, Glazing Gaskets and Glazing Sealants: Comply with Section 088000 "Glazing."

2.7 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard.

2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using head-and-sill-receptor system with shear blocks at intermediate horizontal members.

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- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application and minimum dry film thickness.
 - 1. Color and Gloss: Custom color as selected by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine 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 have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 9200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.5 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.6 ERECTION TOLERANCES

A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

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- a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 084113

SECTION 085653 – ALUMINUM SLIDING 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:
 - 1. Interior sliding windows.
- B. Related Requirements
 - 1. 088000 "Glazing" for glass in sliding window.
 - 2. 123619 "Wood Countertops" for countertop at sliding window.

1.3 COORDINATION

- A. Coordinate installation of anchorages for sliding windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.4 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 window units.
- B. Shop Drawings: For sliding windows.
 - 1. Include plans, elevations, sections and attachments to other work.
 - 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
 - 3. Hardware for sliding window units.
 - 4. Glazing details.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Framing: 12-inch- (305-mm-) long sections of frame members.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Pack sliding windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Store crated sliding windows on raised blocks to prevent moisture damage.

1.7 FIELD CONDITIONS

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

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace sliding windows that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including deflections exceeding 1/4 inch (6 mm).
 - b. Failure of welds.
 - c. Faulty operation of sliding window hardware.
 - d. Deterioration of metals, metal finishes and other materials beyond normal weathering and use.
 - e. Glass breakage.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.

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- b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
 - c. Cracking, peeling, or chipping.
- 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ALUMINUM SLIDING WINDOWS

- A. Provide horizontal-sliding windows.
 - 1. Manufacturers: Basis of Design: Shannon Frameless Pass-Thru Window by Frameless Hardware Company. Subject to compliance with requirements, provide the specified product or equivalent products by one of the following:
 - a. Ready-Access.
 - b. Marvin.
 - c. Specialty Fenestration Group.
- B. Configuration: One fixed-glazed panel and one horizontal-sliding glazed panel.
- C. Framing: Fabricate perimeter framing, mullions and glazing stops from aluminum as follows:
 - 1. Profile: Manufacturer's standard, with minimum face dimension indicated.
 - a. Minimum Face Dimension: As indicated on Drawings.
 - 2. Depth: Manufacturer's standard.
- D. Sliding Window Hardware: Provide roller track designed for overhead support of two- or four-wheel carriage supporting horizontal-sliding glazed panel. Provide manufacturer's standard pull and lock with two keys for horizontal-sliding glazed panel.
- E. Glazing: See 088000 "Glazing."
- F. Materials:
 - 1. Aluminum Extrusions: ASTM B 221 (ASTM B 221M). 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.
 - 2. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M).

2.2 FABRICATION

- A. General: Fabricate sliding windows to provide a complete system for assembly of components and anchorage of window units.

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1. Provide units that are reglazable without dismantling of framing.
- B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
- C. Glazing Stops: Manufacturer's standard, removable.
- D. 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.
- E. 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.
- F. Pre-glazed Fabrication: Pre-glaze window units at factory.

2.3 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.

2.4 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 1. Color: As selected by the Architect from manufacturer's full range.

2.5 ACCESSORIES

- A. Miscellaneous Glazing Materials: Provide material, size and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.
 1. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
 2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
 3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

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- 4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- B. Anchors, Clips and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Sealants: For sealants required within fabricated sliding windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

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 security windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing sliding windows to in-place construction. Include threaded fasteners for inserts and other connectors.
- B. Glazed Framing: Manufacturer's standard sealant or gasket-glazed framing.
- C. Fasteners: Install sliding windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength and finish of adjacent materials.
- D. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.3 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements.

3.4 ADJUSTING

- A. Adjust horizontal-sliding windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
- B. Remove and replace defective work, including sliding windows that are warped, bowed or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

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

END OF SECTION 085653

SECTION 087100 - DOOR HARDWARE

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 commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Storefront doors.
 - 4. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Automatic operators.
 - 4. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 01 Section "General Conditions".
 - 2. Division 01 Section "Operations and Maintenance".
 - 3. Section 061000 "Rough Carpentry".
 - 4. Section 062013 "Interior Finish Carpentry".
 - 5. Section 081113 "Hollow Metal Doors and Frames".
 - 6. Section 081416 "Flush Wood Doors".
 - 7. Section 084113 "Aluminum-Framed Entrances and Storefronts".
 - 8. Division 26 Section "Electrical"
 - 9. Division 28 Section "Integrated Access Control Hardware Devices".
- D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.

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8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

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1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- 1.4 CLOSEOUT SUBMITTALS
- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
 - B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.
- 1.5 QUALITY ASSURANCE
- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
 - B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
 - C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that

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indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures

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- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.
- D. Storefront Doors: Coordinate hardware to be provided and/or installed by storefront provider.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or

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workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge

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pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

- a. Hager Companies (HA) - BB Series, 5-knuckle.
- b. Ives (IV) - 5BB Series, 5-knuckle.
- c. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

- a. Hager Companies (HA).
- b. Ives (IV).
- c. Pemko (PE).

2.4 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. Architectural Builders Hardware (AH) - PT1000-EZ Series.
- b. Pemko (PE) - EL-CEPT Series.
- c. Securitron (SU) - EL-CEPT Series.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

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- a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
2. Manufacturers:
- a. Hager Companies (HA) - Quick Connect.
 - b. McKinney (MK) - QC-C Series.
 - c. dormakaba BEST (ST) - WH Series.

2.5 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 5. Manufacturers:
 - a. Door Controls International (DC).
 - b. Rockwood (RO).
 - c. Trimco (TC).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Pulls shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 6. Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood (RO).
 - c. Trimco (TC).

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2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
 - 1. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA).
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded LFIC mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim LFIC cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 4. Keyway: Match Facility Standard.
- C. High Security Cores: Pick resistance to incorporate two or more independent locking mechanisms including a pin tumbler device with five or six pin chambers, mushroom-shaped driver pins, and sidebar locking mechanism operated independently from the six top pin tumbler device. Cylinder cores with case-hardened inserts protecting both the pin tumbler shear line and the side bar, mushroom-shaped stainless steel driver pins, and stainless steel side pins. Cores to be factory keyed.
 - 1. Cylinder Cores shall have tumbler pins that lift and rotate and shall include at least 3 side pins which all interact with the sidebar to operate.
 - 2. Manufacturers:
 - a. Medeco (MC) - Medeco.
 - b. No Substitution.
- D. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. New System: Key locks to an existing key system as directed by the Owner.
- E. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
- F. Construction Keying: Provide construction master keyed cores.

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G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.8 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 and Security Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA)- 8800 Series.
 - b. Corbin Russwin Hardware (RU) - ML2000 Series.
 - c. Sargent Manufacturing (SA) - 8200 Series.

2.9 ELECTRIC MORTISE LOCKS

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 and Security Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Energy Efficient Design: Provide lock bodies which have a holding current draw of 500mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
2. Include integral request to exits contained within the lock case.
3. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA)- 8890 Series.
 - b. Corbin Russwin Hardware (RU) - ML29000 Series.
 - c. Sargent Manufacturing (SA) - 8270 Series.

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2.10 DEADLOCKS AND LATCHES

- A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Manufacturers:

- a. ASSA ABLOY ACCENTRA (YA)- 350 Series.
- b. Corbin Russwin Hardware (RU) – DL4000 Series.
- c. Sargent Manufacturing (SA) - 4870 Series.

2.11 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip 7/8" LTC Strikes: For locks on door pairs equipped with overlapping astragal.
2. Extra-Long-Lip Strikes: For locks used on frames with applied casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Auxiliary Deadlocks: BHMA A156.36.
3. Dustproof Strikes: BHMA A156.16.

2.12 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

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5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
 2. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA) - 7000 Series.
 - b. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - c. Sargent Manufacturing (SA) - 80 Series.

2.13 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:

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1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Heavy duty surface mounted door closers shall have a 30-year warranty.
 - a. Manufacturers:
 - b. ASSA ABLOY ACCENTRA (YA) - 4400 Series.
 - c. LCN Closers (LC) - 4040 Series.
 - d. Norton Rixson (NO) - 7500 Series.
 - e. Sargent Manufacturing (SA) - 351 Series.

2.14 ELECTROMECHANICAL DOOR OPERATORS

- A. Electromechanical Door Operators (High Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that are UL325/991 and UL10C certified and comply with requirements for the Americans with Disabilities Act (ADA). Operators shall accommodate openings up to 250 pounds and 48" wide. Provide accessories such as custom templates, special mounting brackets, spacers and drop plates as needed for proper installation. Operators shall accommodate openings up to 200 pounds and 48" wide. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide operators with features as follows:
 - a. Non-handed with push and pull side mounting.

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- b. Activation by push button, hands-free or radio frequency devices.
 - c. Adjustable opening force and closing power.
 - d. Two-year limited warranty.
 - e. Wi-Fi interface where the operator is a secure, password protected WiFi hot spot with no connection to building's IT required.
 - 1) Simple setup with no app required.
 - 2) View status and make adjustments without removing the cover.
 - 3) Built-in logic to support single use restroom applications with no external relay boards, logic modules, position switches required.
 - f. Mounting backplate to simplify and speed up installation.
 - g. Integration with access control systems.
2. Operators shall have the following functionality:
- a. Adjustable Hold Open: Amount of time a door will stay in the full open position after an activation.
 - b. Blow Open for Smoke Ventilation: Door opens when signal is received from alarm system allowing air or smoke to flow through opening. Door will stay open until signal from alarm system is stopped.
 - c. Emergency Interface Relay: Door closes and ignores any activation input until signal is discontinued.
 - d. Infinite Hold Open: Door will hold open at set position until power is turned off.
 - e. Latch Assist: At closed position, after an activation, the door is pulled in. After the door has closed, the door is pulled in to assist with latch release/engagement.
 - f. Obstruction Detection: Door closes if it hits an obstruction while opening; door will reverse to open position if it hits an obstruction while closing. Door will stop once it hits an obstruction and will rest against the obstruction until removed.
 - g. Open Delay: Delays operator opening for locking hardware.
 - h. Outside Wall Switch Disable: When contact is closed, outside wall switch is disabled.
 - i. Power Assist: Senses the door is being opened manually and applies small amount of power to assist the user in opening the door with force less than 5 lbs. The door opens only as far as it is moved manually, then closes once released.
 - j. Power Close: Additional force to assist door closing between 7° and 2°.
 - k. Presence Detector Input: Input for external sensor to detect presence at door open or close position only.
 - l. Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.
 - m. Selector Mode Switch: Off disables the signal inputs unless Blow Open is activated, on activates the signal inputs, hold open activates the unit (unless Blow Closed is activated) to the hold open position.
 - n. Vestibule Delay: When the wall switch is pressed, first door in vestibule will open. Second door will open once vestibule door delay has expired. Delay is adjustable.
 - o. Executive Mode Feature: When the door receives an activation signal it opens and remains open until either a second signal is received, or the door is manually moved in closing direction.

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3. Manufacturers:

- a. LCN Closers (LC) - 9100 Series.
- b. Horton Automatics (HO) - S4100LE Series.
- c. Norton Rixson (NO) - 6000 Series.

2.15 ARCHITECTURAL TRIM AND ACCESSORIES

- A. Door, Frame and Wall Protective Trim: ANSI/BHMA A156.6, protective products as specified in the hardware sets. Door protection plates shall be not more than 2" less than door width on stop side and 1" less door width on the pull side or on stop side of pairs of doors. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide protective trim with functions and features as follows:

- a. Meets ADA requirements for smooth bottom door surfaces.
- b. UL Classified options for use on fire-rated doors up to 3 hours.
- c. Fabricated from stainless steel, brass, bronze, aluminum, or high-impact plastic.
- d. Available in a variety of sizes, finishes, and profiles to suit aesthetic and functional requirements.
- e. Designed to protect doors, frames, and adjacent walls from damage due to impact, abrasion, or traffic.
- f. Fasteners included; adhesive-backed options available for select models.
- g. Ten-year limited warranty.

2. Manufacturers:

- a. Burns Manufacturing (BU).
- b. Rockwood (RO).
- c. Trimco (TC).

2.16 DOOR STOPS AND HOLDERS

- A. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

- a. Burns Manufacturing (BU).
- b. Rockwood (RO).
- c. Trimco (TC).

- B. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of

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extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:
 - a. Norton Rixson (NO).
 - b. Rockwood (RO).
 - c. Sargent Manufacturing (SA).

2.17 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
 1. Manufacturers:
 - a. National Guard Products (NG).
 - b. Pemko (PE).
 - c. Zero (ZE).

2.18 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

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2.19 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.
- C. Storefront Doors: Comply with Section 084114 "Aluminum-Framed Entrances and Storefronts."

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

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2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

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- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The 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.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
- B. Manufacturer's Abbreviations:
 - 1. MK - McKinney
 - 2. PE - Pemko
 - 3. RO - Rockwood
 - 4. SA - SARGENT
 - 5. YA - ASSA ABLOY ACCENTRA
 - 6. MC - Medeco
 - 7. RF - Rixson
 - 8. NO - Norton Rixson
 - 9. LC - LCN Closers
 - 10. BM - Besam
 - 11. OT - Other
 - 12. SU - Securitron

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Hardware Sets

Set: PC - 1.0

Doors: 100

2 Continuous Hinge	_FM_SLF-HD1 EL-CEPTx32D		PE
1 Mullion	L980A	US28	SA
1 Rim Exit Device, Exit Only	55 56 AD8510 EO	US32D	SA
1 Rim Exit Elec Device, Key Trim	LC 55 56 AD8504 Less Pull	US32D	SA
1 Mullion Cylinder Kit	980C1	US26D	SA
1 Rim Cylinder	1193 Temp Core-6 pin	626	YA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
2 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26	MC
2 Pull	RM201	US32D	RO
2 Conc Overhead Stop	6 Series	689	RF
1 Automatic Opener	9153 .ARM as req (dual-push)	.628	LC
1 Gasketing	By Alum Door Manu.		OT
1 Rain Guard	346C		PE
2 Sweep	345C		PE
1 Threshold	171A		PE
2 ElectroLynx Harness	QC-C**** x Length Required		MK
2 ElectroLynx Harness	QC-C1500P		MK
2 Position Switch	Provided by Owner's Security Vendor		SU
1 Door Switch	505		NO
1 Switch Post	500	689	NO
1 Power Supply	Provided by Owner's Security Vendor		SU
1 Card Reader	Provided by Owner's Security Vendor		OT
1 Wiring Diagrams	Elevation & Point-to-Point		OT

Notes: Coordinate all components with all subs and trades to ensure operational function desired is met and no scope gaps/overlap occur.

Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader retracting latch for a predetermined time limit and engaging operator. Latch can remain unlocked for open access during park center open hours.
3. Egress free for immediate exit. ADA egress by actuator.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed/latched status.
6. Exit Device remains locked (fail secure), door latched in event of power loss. Keyed cylinder override for emergency access.

COUNTY OF WAKE
LAKE MYRA COUNTY PARK PHASE 1

Set: PC - 2.0

Doors: 121, 122

1 Continuous Hinge	_FM_SLF-HD1 EL-CEPTx32D	PE
1 Rim Exit Elec Device, Key Trim	55 56 AD8504 Less Pull	US32D SA
1 Rim Cylinder	1193 Temp Core-6 pin	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Pull	RM201	US32D RO
1 Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689 LC
1 Gasketing	By Alum Door Manu.	OT
1 Rain Guard	346C	PE
1 Sweep	345C	PE
1 Threshold	171A	PE
1 ElectroLynx Harness	QC-C**** x Length Required	MK
1 ElectroLynx Harness	QC-C1500P	MK
1 Position Switch	Provided by Owner's Security Vendor	SU
1 Power Supply	Provided by Owner's Security Vendor	SU
1 Card Reader	Provided by Owner's Security Vendor	OT
1 Wiring Diagrams	Elevation & Point-to-Point	OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader retracting latch for a predetermined time limit.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed/latched status.
6. Exit Device remains locked (fail secure), door latched in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 3.0

Doors: 100A

2 Continuous Hinge	_FM_SLF-HD1	PE
1 Rim Exit Device, Exit Only	AD8510 EO	US32D SA
1 Rim Exit Device, Key Trim	LC AD8504 Less Pull	US32D SA
1 Rim Cylinder	1193 Temp Core-6 pin	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
2 Pull	RM201	US32D RO
2 Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689 LC
1 Gasketing	By Alum Door Manu.	OT

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1 Rain Guard	346C	PE
2 Sweep	345C	PE
1 Threshold	171A	PE
2 Position Switch	Provided by Owner's Security Vendor	SU

Set: PC - 4.0

Doors: 114, 121A, 122A

1 Continuous Hinge	_FM_SLF-HD1	PE
1 Rim Exit Device, Key Trim	AD8504 Less Pull	US32D SA
1 Rim Cylinder	1193 Temp Core-6 pin	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Pull	RM201	US32D RO
1 Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689 LC
1 Gasketing	By Alum Door Manu.	OT
1 Rain Guard	346C	PE
1 Sweep	345C	PE
1 Threshold	171A	PE
1 Position Switch	Provided by Owner's Security Vendor	SU

Set: PC - 5.0

Doors: 101A

2 Hinge, Full Mortise	TA2314	US32D MK
1 Hinge, Full Mortise	TA2314 QC	US32D MK
1 Rim Exit Elec Device, Storeroom	LC 55 56 8804 ETJ	US32D SA
1 Rim Cylinder	1193 Temp Core-6 pin	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Gasketing	303AS	PE
1 Rain Guard	346C	PE
1 Sweep	345C	PE
1 Threshold	171A	PE
1 ElectroLynx Harness	QC-C**** x Length Required	MK
1 ElectroLynx Harness	QC-C1500P	MK
1 Position Switch	Provided by Owner's Security Vendor	SU
1 Power Supply	Provided by Owner's Security Vendor	SU
1 Card Reader	Provided by Owner's Security Vendor	OT
1 Wiring Diagrams	Elevation & Point-to-Point	OT

COUNTY OF WAKE

LAKE MYRA COUNTY PARK PHASE 1

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader retracting latch trim for a predetermined time limit. Latch can remain retracted for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed/latched status.
6. Exit Device remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 6.0

Doors: B01

5 Hinge, Full Mortise	TA2314	US32D MK
1 Hinge, Full Mortise	TA2314 QC	US32D MK
1 Flush Bolt	2842	US32D RO
1 Flush Bolt	2845	US32D RO
1 Dust Proof Strike	570	US4 RO
1 Fail Secure Elec Lock	RX 8271-24V OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Coordinator	2600 Series size to opening	US28 RO
2 Mounting Bracket	2601D	US28 RO
2 Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689 LC
2 Kick Plate	K1050 8" high CSK	US32D RO
1 Astragal	357SP x S88	PE
1 Gasketing	303AS	PE
1 Rain Guard	346C	PE
2 Sweep	345C	PE
1 Threshold	171A	PE
1 ElectroLynx Harness	QC-C**** x Length Required	MK
1 ElectroLynx Harness	QC-C1500P	MK
2 Position Switch	Provided by Owner's Security Vendor	SU
1 Power Supply	Provided by Owner's Security Vendor	SU
1 Card Reader	Provided by Owner's Security Vendor	OT
1 Wiring Diagrams	Elevation & Point-to-Point	OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

4. Lever remains locked (fail secure), doors latched in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 7.0

Doors: B03

6 Hinge, Full Mortise	TA2314	US32D MK
1 Flush Bolt	555/557	US4 RO
1 Dust Proof Strike	570	US4 RO
1 Storeroom/Closet Lock	LC 8204 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Surface Overhead Holder/Stop	7-326	689 NO
1 Surface Closer	4040XP .SHCUSH	.689 LC
2 Kick Plate	K1050 8" high CSK	US32D RO
1 Astragal	357SP x S88	PE
1 Gasketing	303AS	PE
1 Rain Guard	346C	PE
2 Sweep	345C	PE
1 Threshold	171A	PE
2 Position Switch	Provided by Owner's Security Vendor	SU

Set: PC - 8.0

Doors: 118

3 Hinge, Full Mortise	TA2314	US32D MK
1 Dormitory (Privacy) Lock	LC V21 8225 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Mop Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
1 Gasketing	303AS	PE
1 Rain Guard	346C	PE
1 Sweep	345C	PE
1 Threshold	171A	PE
1 Position Switch	Provided by Owner's Security Vendor	SU

COUNTY OF WAKE
LAKE MYRA COUNTY PARK PHASE 1

Set: PC - 9.0

Doors: 115, 117

2 Hinge, Full Mortise	TA2314	US32D MK
1 Hinge, Full Mortise	TA2314 QC	US32D MK
1 Classroom Deadlock	LB LC 28 4877	US26D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26 MC
1 Pull Plate	107x70C	US32D RO
1 Push Plate	70C-RKW	US32D RO
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Mop Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
1 Gasketing	303AS	PE
1 Rain Guard	346C	PE
1 Sweep	345C	PE
1 Threshold	171A	PE
1 Position Switch	Provided by Owner's Security Vendor	SU

Notes: Prep door for wire transfer

Set: PC - 10.0

Doors: 101

2 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Hinge, Full Mortise	TA2714-MCK QC	US26D MK
1 Rim Exit Elec Device, Storeroom	LC 55 56 8804 ETJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Surface Closer	4040XP .EDA	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
3 Silencer	608-RKW	RO
1 ElectroLynx Harness	QC-C**** x Length Required	MK
1 ElectroLynx Harness	QC-C1500P	MK
1 Power Supply	Provided by Owner's Security Vendor	SU
1 Card Reader	Provided by Owner's Security Vendor	OT

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1 Wiring Diagrams

Elevation & Point-to-Point

OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader retracting latch for a predetermined time limit. Latch can remain retracted for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Exit Device remains locked (fail secure), door latched in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 11.0

Doors: 104

2 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Hinge, Full Mortise	TA2714-MCK QC	US26D MK
1 Fail Secure Elec Lock	RX 8271-24V OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
3 Silencer	608-RKW	RO
1 ElectroLynx Harness	QC-C**** x Length Required	MK
1 ElectroLynx Harness	QC-C1500P	MK
1 Position Switch	Provided by Owner's Security Vendor	SU
1 Power Supply	Provided by Owner's Security Vendor	SU
1 Card Reader	Provided by Owner's Security Vendor	OT
1 Wiring Diagrams	Elevation & Point-to-Point	OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. Door position switch monitors open/closed/latched status.
5. Lever remains locked (fail secure), door latched in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 12.0

Doors: B02

2 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Hinge, Full Mortise	TA2714-MCK QC	US26D MK
1 Fail Secure Elec Lock	RX 8271-24V OJ	US32D SA

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1 Surf Overhead Stop	10 Series	689	RF
1 Surface Closer	4040XP .REGARM	.689	LC
3 Silencer	608-RKW		RO
1 ElectroLynx Harness	QC-C**** x Length Required		MK
1 ElectroLynx Harness	QC-C1500P		MK
1 Position Switch	Provided by Owner's Security Vendor		SU
1 Power Supply	Provided by Owner's Security Vendor		SU
1 Key Pad	Provided By Security Supplier		OT
1 Card Reader	Provided by Owner's Security Vendor		OT
1 Wiring Diagrams	Elevation & Point-to-Point		OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. Door position switch monitors open/closed/latched status.
5. Lever remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 13.0

Doors: 121B

Description: Classroom from Corridor

2 Hinge, Full Mortise	TA2714-MCK	US26D	MK
1 Hinge, Full Mortise	TA2714-MCK QC	US26D	MK
1 Fail Secure Elec Lock	RX 8271-24V OJ	US32D	SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1 Medeco-Bilevel IC Core	Type as required - furnished by Owner	26	MC
1 Surface Closer	4040XP .REGARM	.689	LC
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D	RO
1 Gasketing	S88BL		PE
1 ElectroLynx Harness	QC-C**** x Length Required		MK
1 ElectroLynx Harness	QC-C1500P		MK
1 Position Switch	Provided by Owner's Security Vendor		SU
1 Power Supply	Provided by Owner's Security Vendor		SU
1 Card Reader	Provided by Owner's Security Vendor		OT
1 Wiring Diagrams	Elevation & Point-to-Point		OT

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. Door position switch monitors open/closed/latched status.
5. Lever remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

Set: PC - 14.0

Doors: 105, 112

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Classroom Lock	LC 8237 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
3 Silencer	608-RKW	RO

Set: PC - 15.0

Doors: B01B

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Storeroom/Closet Lock	LC 8204 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
3 Silencer	608-RKW	RO
1 Position Switch	Provided by Owner's Security Vendor	SU

Set: PC - 16.0

Doors: B01A

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Storeroom/Closet Lock	LC 8204 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Surface Closer	4040XP .CUSH	.689 LC

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1 Kick Plate	K1050 8" high CSK	US32D RO
3 Silencer	608-RKW	RO

Set: PC - 17.0

Doors: 120, 121C, 122B

6 Hinge, Full Mortise	TA2714-MCK	US26D MK
2 Flush Bolt	555/557	US4 RO
1 Dust Proof Strike	570	US4 RO
1 Classroom Lock	LC 8237 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
2 Conc Overhead Stop	6 Series	689 RF
2 Kick Plate	K1050 8" high CSK	US32D RO
1 Astragal	S771C	PE
2 Silencer	608-RKW	RO

Set: PC - 18.0

Doors: 107, 109

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Office/Entry Lock	LC 8205 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
3 Silencer	608-RKW	RO

Set: PC - 19.0

Doors: 114A, 116

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Storeroom/Closet Lock	LC 8204 OJ	US32D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
3 Silencer	608-RKW	RO

Set: PC - 20.0

Doors: 103, 106

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Privacy Lock	V21 8266 OJ	US32D SA
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Mop Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
1 Gasketing	S88BL	PE

Set: PC - 21.0

Doors: 115A, 117A

3 Hinge, Full Mortise	TA2714-MCK	US26D MK
1 Classroom Deadlock	LB LC 28 4877	US26D SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626 YA
1 Core	1210 GMK CKC2	626 YA
1 Pull Plate	107x70C	US32D RO
1 Push Plate	70C-RKW	US32D RO
1 Surface Closer	4040XP .REGARM	.689 LC
1 Kick Plate	K1050 8" high CSK	US32D RO
1 Mop Plate	K1050 8" high CSK	US32D RO
1 Wall Stop	403 (or) 441CU (As Required)	US26D RO
1 Gasketing	S88BL	PE
1 Position Switch	Provided by Owner's Security Vendor	SU

Set: MF - 1.0 - SET NOT USED**Set: MF - 2.0**

Doors: 100, 105

1 Continuous Hinge	_FM_SLF-HD1 EL-CEPTx32D	PE
1 Rim Exit Elec Device, Storeroom	55 56 AD8504 Less Pull	US32D SA
1 Rim Cylinder	1193 Temp Core-6 pin	626 YA
1 Medeco-Bilevel IC Core	Type as required - Furnished by Owner	26 MC
1 Pull	RM201	US32D RO
1 Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689 LC
1 Gasketing	By Alum Door Manu.	OT
1 Rain Guard	346C	PE

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1	Sweep	345C	PE
1	Threshold	171A	PE
1	ElectroLynx Harness	QC-C**** x Length Required	MK
1	ElectroLynx Harness	QC-C1500P	MK
1	Position Switch	Provided By Owner's Security Vendor	SU
1	Key Pad	Provided By Owner's Security Vendor	OT
1	Card Reader	Provided By Owner's Security Vendor	OT
1	Power Supply	Provided By Owner's Security Vendor	SU
1	Wiring Diagrams	Elevation & Point-to-Point	OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader or valid pin retracting latch for a predetermined time limit. Latch can remain retracted for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed/latched status.
6. Exit Device remains locked (fail secure), door latched in event of power loss. Keyed cylinder override for emergency access.

Set: MF - 3.0

Doors: 107C

2	Hinge, Full Mortise	TA2314	US32D	MK
1	Hinge, Full Mortise	TA2314 QC	US32D	MK
1	Rim Exit Elec Device, Storeroom	LC 55 56 8804 ETJ	US32D	SA
1	Rim Cylinder	1193 Temp Core-6 pin	626	YA
1	Medeco-Bilevel IC Core	Type as required - Furnished by Owner	26	MC
1	Surface Closer	4040XP .SCUSH (Drop Plate if req)	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Gasketing	303DS		PE
1	Rain Guard	346C		PE
1	Sweep	345C		PE
1	Threshold	171A		PE
1	ElectroLynx Harness	QC-C**** x Length Required		MK
1	ElectroLynx Harness	QC-C1500P		MK
1	Position Switch	Provided By Owner's Security Vendor		SU

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1	Card Reader	Provided By Owner's Security Vendor	OT
1	Power Supply	Provided By Owner's Security Vendor	SU
1	Wiring Diagrams	Elevation & Point-to-Point	OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed/latched status.
6. Exit Device remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

Set: MF - 4.0

Doors: 106

3	Hinge, Full Mortise	TA2714-MCK	US26D	MK
1	Office/Entry Lock	LC 8205 OJ	US32D	SA
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Core	1210 GMK CKC2	626	YA
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO
3	Silencer	608-RKW		RO

Set: MF - 5.0

Doors: 101

2	Hinge, Full Mortise	TA2714-MCK	US26D	MK
1	Hinge, Full Mortise	TA2714-MCK QC8	US26D	MK
1	Fail Secure Elec Lock	LC RX 8271-V OJ	US32D	SA
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Core	1210 GMK CKC2	626	YA
1	Surface Closer	4040XP .REGARM	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO
3	Silencer	608-RKW		RO
1	ElectroLynx Harness	QC-C**** x Length Required		MK
1	ElectroLynx Harness	QC-C1500P		MK

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1	Position Switch	Provided By Owner's Security Vendor	SU
1	Card Reader	Provided By Owner's Security Vendor	OT
1	Power Supply	Provided By Owner's Security Vendor	SU
1	Wiring Diagrams	Elevation & Point-to-Point	OT

Notes: Operational Narrative:

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. Door position switch monitors open/closed/latched status.
5. Lever remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

Set: MF - 6.0

Doors: 103

3	Hinge, Full Mortise	TA2714-MCK	US26D	MK
1	Storeroom/Closet Lock	LC 8204 OJ	US32D	SA
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Core	1210 GMK CKC2	626	YA
1	Surface Closer	4040XP .REGARM	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO
1	Gasketing	S773BL		PE
1	Door Bottom	420APKL 36"		PE
1	Threshold	151A MSES25SS		PE

Set: MF - 7.0

Doors: 107

Description: Work Bays to Corridor

3	Hinge, Full Mortise	TA2714-MCK	US26D	MK
1	Classroom Lock	LC 8237 OJ	US32D	SA
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Core	1210 GMK CKC2	626	YA
1	Surface Closer	4040XP .REGARM	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO

COUNTY OF WAKE**LAKE MYRA COUNTY PARK PHASE 1**

1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO
3	Silencer	608-RKW		RO

Set: MF - 8.0

Doors: 102

3	Hinge, Full Mortise	TA2714-MCK	US26D	MK
1	Privacy Lock	V21 8266 OJ	US32D	SA
1	Surface Closer	4040XP .REGARM	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Mop Plate	K1050 8" high CSK	US32D	RO
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO
1	Gasketing	S88BL		PE

Set: MF - 9.0

Doors: 107A, 107B

1	Position Switch	Provided By Owner's Security Vendor		SU
	All Hardware	By Door Manufacturer		OT

Set: WP - 1.0

Doors: 101, 103

2	Hinge, Full Mortise	TA2314	US32D	MK
1	Hinge, Full Mortise	TA2314 CC4-18	US32D	MK
1	Trilogy Mortise Privacy Push Button Lock	DL4500 DB x hard-wired option	26D	AL
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Perm IC Core	1210 GMK	626	YA
1	Surface Closer	4040XP .SCUSH	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Mop Plate	K1050 8" high CSK	US32D	RO
1	Gasketing	303DS		PE
1	Rain Guard	346C		PE
1	Sweep	345C		PE
1	Threshold	171A		PE
1	Alarm Lock Wiring Door Harness	4-wire x Length Required		AL
1	ElectroLynx Frame Harness	QC-C1500P		MK
1	Position Switch	Provided By Owner's Security Vendor		SU

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1 Power Supply Provided By Owner's Security Vendor SU
 Note: Prep door for wire chase harness & frame for harness

Set: WP - 2.0

Doors: 104, 105

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Storeroom/Closet Lock	LC 8204 OJ	US32D	SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1 Medeco-Bilevel IC Core	Type as required - Furnished by Owner	26	MC
1 Surface Closer	4040XP .SCUSH	.689	LC
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Mop Plate	K1050 8" high CSK	US32D	RO
1 Gasketing	303DS		PE
1 Rain Guard	346C		PE
1 Sweep	345C		PE
1 Threshold	171A		PE

Set: WP - 3.0

Doors: 102

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Storeroom/Closet Lock	LC 8204 OJ	US32D	SA
1 Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1 Medeco-Bilevel IC Core	Type as required - Furnished by Owner	26	MC
1 Surface Closer	4040XP .SCUSH	.689	LC
1 Kick Plate	K1050 8" high CSK	US32D	RO
1 Mop Plate	K1050 8" high CSK	US32D	RO
1 Gasketing	303DS		PE
1 Rain Guard	346C		PE
1 Sweep	345C		PE
1 Threshold	171A		PE
1 Position Switch	Provided By Owner's Security Vendor		SU

Set: ES - 1.0

Doors: 101, 102, 103, 104

2 Hinge, Full Mortise	TA2314	US32D	MK
1 Hinge, Full Mortise	TA2314 CC4-18	US32D	MK

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1	Trilogy Mortise Privacy Push Button Lock	DL4500 DB x hard-wired option	26D	AL
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Perm IC Core	1210 GMK	626	YA
1	Surface Closer	4040XP .SCUSH	.689	LC
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Mop Plate	K1050 8" high CSK	US32D	RO
1	Gasketing	303DS		PE
1	Rain Guard	346C		PE
1	Sweep	345C		PE
1	Threshold	171A		PE
1	Alarm Lock Wiring Door Harness	4-wire x Length Required		AL
1	ElectroLynx Frame Harness	QC-C1500P		MK
1	Position Switch	Provided By Owner's Security Vendor		SU
1	Power Supply	Provided By Owner's Security Vendor		SU

Note: Prep door for wire chase harness & frame for harness

Set: ES - 2.0

Doors: 105

6	Hinge, Full Mortise	TA2314	US32D	MK
2	Flush Bolt	555/557	US4	RO
1	Dust Proof Strike	570	US4	RO
1	Storeroom/Closet Lock	LC 8204 OJ	US32D	SA
1	Mortise Cylinder	2196 Temp Core-6 pin (verify cam)	626	YA
1	Medeco-Bilevel IC Core	Type as required - Furnished by Owner	26	MC
1	Surface Overhead Holder/Stop	7-326	689	NO
1	Surface Closer	4040XP .SHCUSH	.689	LC
4	Kick Plate	K1050 8" high CSK	US32D	RO
1	Astragal	357SP		PE
1	Gasketing	303DS		PE
1	Rain Guard	346C		PE
2	Sweep	345C		PE
1	Threshold	171A		PE
2	Position Switch	Provided By Owner's Security Vendor		SU

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Bird deterrent glass.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames."
2. Section 081416 "Flush Wood Doors."
3. Section 084113 "Aluminum-Framed Entrances and Storefronts."
4. Section 085653 "Aluminum Sliding Windows."

1.2 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 in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

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

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1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
 1. Monolithic glass
 2. Insulating glass.
 3. Bird deterrent glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with 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.

1.8 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).

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for 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 obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

- C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Guardian Glass
 2. Pilkington Building Products North America.

3. Vitro

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 defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
 - 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
 - 5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.
- E. Acoustic Performance:
 - 1. Exterior Glazing: 33 OITC.
 - 2. Interior Glazing: 37 STC.

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. 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 or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
 - 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 as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

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1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

2.6 BIRD-FRIENDLY SOLAR CONTROL COATED INSULATING GLASS

A. Double-Glazed Acid-Etched Sputter-Coated Insulating Glass Units:

1. BOD: Guardian Bird1st Etch DX22
2. Conformance: ASTM E 2190.
3. Outboard Lite:
 - a. Acid-etched etched bird deterrent
 - b. Vacuum Deposition Sputtered Coating: ASTM C 1376.
4. Glass Unit Performance Characteristics:
 - a. Threat Factor: 23 (based on the American Bird Conservancy tunnel test)
 - b. Avoidance Index: 77 (based on the American Bird Conservancy tunnel test)
 - c. Meets the Bird-Friendly industry recognized 2x4 Rule.

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 of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, 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 C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

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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 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, recommended in writing by 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:
 1. EPDM or Silicone with Shore A durometer hardness of 85, plus or minus 5.
 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
 1. EPDM or Silicone with Shore A durometer hardness per manufacturer's written instructions.
 2. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 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.

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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. 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.

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- 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 in accordance with 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.

3.4 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 in writing 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 in writing by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.5 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.

3.6 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 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.

3.7 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type: Fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.8 INSULATING GLASS SCHEDULE

- A. All Insulating glass shall be fully tempered.

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B. Low-E-Coated, Clear Insulating Glass Type:

1. Locations: See Window Elevations
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
8. Safety glazing required.

C. Low-E-Coated, Clear Insulating Glass with Bird Deterrent Type:

1. Locations: See Window Elevations
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass with etched bird deterrent.
5. Interspace Content: Argon.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
8. Safety glazing required.

END OF SECTION 088000

SECTION 089119 - FIXED LOUVERS

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. Fixed extruded-aluminum louvers.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants"
 - 2. Section 08 1113 "Hollow Metal Doors and Frames" for louvers in hollow-metal frames.

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 axis of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axis 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. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.
- F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

1.4 ACTION SUBMITTALS

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

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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, flashings, sealants, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 FIELD CONDITIONS

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

1.7 WARRANTY

- A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 1. Deterioration includes, but is not limited to, the following:

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- a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, peeling, or chipping.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers 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 are considered to act normal to the face of the building.
 1. Wind Loads:
 - a. Determine loads based on pressures as indicated on Drawings.
- B. 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 in accordance with AMCA 500-L.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven-Rain-Resistant Louver, Extruded Aluminum:
 1. Louver Depth: 6 inches (100 mm).
 2. Frame and Blade Nominal Thickness: Not less than 0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames.
 3. Mullion Type: Exposed.

4. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Air Performance:
 - 1) Not more than 0.10-inch wg (25-Pa) static pressure drop at 750-fpm (3.8-m/s) free-area [exhaust] [intake] velocity.
 - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s) at a free-area velocity 2149 feet per minute.
 - d. Must meet the AMCA-550 Requirement.
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: Bird screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
 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. Bird Screening, Aluminum: 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.

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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.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

- A. Factory assemble louvers 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.
 2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies 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: Manufacturer's standard.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.

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- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range
- C. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color and Gloss: As selected by Architect from manufacturer's full range. Custom color may be required to match storefront systems.

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 of the Work.
- 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 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. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

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- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 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 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- B. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- C. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.

2.2 FRAMING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Clark Dietrich.
 - 2. Scafco Steel Stud Company.
 - 3. Steel Network, The.
- B. Framing Members, General: Comply with AISI S220 for conditions indicated.
 - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- C. Studs and Track: AISI S220.
 - 1. Minimum Base-Steel Thickness: 20-gauge for 3-5/8-inch and 18-gauge for 6-inch studs. 16-gauge steel used where called out in the drawings.
 - a. Equivalent gauge steel will not be accepted.
 - 2. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide the following:
 - 1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38 mm).
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
 - 1. Minimum Base-Steel Thickness: 20-gauge.
 - 2. Depth: 7/8 inch (22.2 mm).

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- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm)] o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

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- 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 061600 "Sheathing" for glass mat gypsum sheathing for exterior walls.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
3. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Mold-resistant gypsum board.
5. Interior trim.
6. Joint treatment materials.
7. Laminating adhesive.
8. Sound-attenuation blankets.
9. Acoustical sealant.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 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.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, 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, moisture damaged, or 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 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corp.
 - 2. Georgia-Pacific Gypsum LLC.
 - 3. Lafarge North America, Inc.
 - 4. National Gypsum Company.
 - 5. USG Corporation.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.3 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.

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2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated in plans.
 - 1. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
 - 2. Finish: Architect to select from manufacturer's full range.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.

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- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

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

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- 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 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- 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 (1.5 mm) 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. (0.7 sq. m) 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- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- 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 C919 and with manufacturer's written instructions 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 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:

- 1. Standard: Vertical surfaces unless otherwise indicated.
- 2. Type X: At rated walls and as indicated in drawings.
- 3. Ceiling Type: Ceiling surfaces.
- 4. Mold-Resistant Type: In wet areas and as indicated on Drawings.

- B. 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.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
- 3. On Z-shaped 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.
- 5. Stop Gypsum Board 1/4" above the floor.

- C. Multilayer Application:

- 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
- 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

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4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

- D. 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 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF 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 joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated on Drawings.

3.6 FINISHING OF 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 C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 3: Panels that are substrate for wallcovering or acoustical panels.

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4. 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 099123 "Interior Painting."

- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 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 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed and matte wall tile.
2. Cementitious backer units.
3. Waterproof membrane.
4. Porcelain tile.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Waterproof membrane.
 - 2. Crack isolation membrane.
 - 3. Cementitious backer units.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.3 TILE PRODUCTS

- A. Wall Tile Type: (WT-1, WT-2, WT-3, WT-4, WT-5 & WT-6)
 - 1. Basis of Design: As indicated in the Finish Schedules on the drawings. Subject to compliance with requirements, provide the named products or comparable products by one of the equals indicated in the Finish Schedule.
 - 2. Module Sizes: As indicated in the Finish Schedules on the drawings.
 - 3. Thickness: Manufacturer's standard
 - 4. Face: Plain with cushioned edges.
 - 5. Finish: Bright, clear and Matte, opaque glaze, as indicated in the Finish Schedules.
 - 6. Tile Color and Pattern: As indicated in the Finish Schedules on the drawings.
 - 7. Grout Color: As indicated in the Finish Schedules on the drawings.
 - 8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module sizes to match wall tiles.
 - b. External Corners for Thinset Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - c. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.
- B. Floor Tile Type: (PORF-1 & PORF-2)
 - 1. Basis of Design: As indicated in the Finish Schedules on the drawings. Subject to compliance with requirements, provide the named products or comparable products by one of the equals indicated in the Finish Schedule.
 - 2. Module Size: As indicated in the Finish Schedules on the drawings.
 - 3. Thickness: Manufacturer's standard
 - 4. Face: Plain with cushioned edges.
 - 5. Finish: Bright, clear and Matte, opaque glaze, as indicated in the Finish Schedules.
 - 6. Tile Color and Pattern: As indicated in the Finish Schedules on the drawings.
 - 7. Grout Color: As indicated in the Finish Schedules on the drawings.
 - 8. Mounting:

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9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module size to match wall tile.
 - b. External Corners for Thinset Mortar Installations: Surface bullnose, same size as adjoining flat tile.
 - c. Internal Corners: Field-butt square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
 1. Thickness: 5/8 inch (15.9 mm).
 2. Joint Tape as recommended by panel manufacturer.

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.6 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
 1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.7 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.

- C. High-Performance Tile Grout: ANSI A118.7.
 - 1. Polymer Type:
 - a. Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
- D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 - 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.8 MISCELLANEOUS MATERIALS

- A. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- B. Corners: As indicated in Drawings.
- C. Tile Base Caps: As indicated in drawings.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Glazed Wall Tile: 1/16 inch (1.6 mm).
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

3.3 INSTALLATION OF TILE BACKING PANELS

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

- A. Protect installed tile work during construction period to prevent staining, damage and wear.
- B. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips and other ceiling attachment devices to be cast in concrete.
- C. Related Sections:
 - 1. Divisions 22, 23, 26 and 27 for items to run above ceiling and items to be installed in grid.

1.3 PREINSTALLATION MEETINGS

Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes 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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed, but no less than 1 full box.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.
- B. Basis of Design: Acoustical ceilings are based on Ultima, as manufactured by Armstrong World Industries. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. CertainTeed Corp.
 - 2. USG Interiors, Inc.
- C. Classification: Provide panels as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.
 - 2. Pattern: CE (perforated, small holes and lightly textured).

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- B. Classification: Provide panels as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.
 - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. Light Reflectance (LR): Not less than 0.85.
- E. Ceiling Attenuation Class (CAC): Not less than 35.
- F. Noise Reduction Coefficient (NRC): Not less than 0.85.
- G. Articulation Class (AC): Not less than 170.
- H. Edge/Joint Detail: Beveled tegular. Reveal sized to fit flange of exposed suspension-system members].
- I. Thickness: 1-inch (25 mm)].
- J. Modular Size: 24 by 24 inches (610 by 610 mm).
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel or aluminum.
 - 5. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
 - 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- (3.5-mm-) diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.

2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.
 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to

- support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:

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2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- B. Acoustical panel ceiling hangers, anchors and fasteners will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND 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. Thermoplastic-rubber base.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

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- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE (RB-1, RB-2)

- A. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style B, Cove: Provide in areas with polished concrete.
 - b. Style C, Toeless: Provide in areas with carpet.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Roppe Corporation.
 - b. Flexco, Inc.
 - c. Johnsonite.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: See Finish Legend in drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: See Finish Legend in drawings.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.

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- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed outside corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 24 inches in length.
 - a. Miter corners to minimize open joints.
 - 2. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 24 inches in length.
 - a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.

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- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096723 - RESINOUS EPOXY 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. Resinous flooring systems with integral cove base.
- B. Related Sections:
 - 1. Section 079200 "Joint Sealants" for sealants installed at joints in resinous flooring systems.

1.3 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, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Resinous epoxy flooring is based on Deco Quartz as manufactured by Sherwin-Williams Company. Subject to compliance with requirements, provide the named products or comparable products by one of the following:

- 1. American Hi-Tech Flooring Company.
- 2. Epoxy Systems, Inc.

2.2 INDUSTRIAL RESINOUS FLOORING

- A. Resinous Flooring: Abrasion-impact-and chemical-resistant, industrial-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. System Characteristics:
 - 1. Color and Pattern: Refer to finish plan in drawings.
 - 2. Wearing Surface: Manufacturer's standard wearing surface.
 - 3. Base: 6-inches cove.
- C. Primer: Manufacturer's standard.
- D. Chip Broadcast: Manufacturer's standard.
- E. Second Chip Broadcast: Manufacturer's standard.

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- F. Grout Coat: Clear or Ultra Clear.
- G. Topcoat: Apply as required for manufacturer's recommended minimum dry film thickness.
- H. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion in the following reagents for no fewer than seven days:

2.3 ACCESSORIES

- A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 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, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
 - 1. Apply waterproofing membrane to integral cove base substrates.
- D. Integral Cove Base: 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, and topcoating of cove base. Round internal and external corners.
 - 1. Integral Cove Base: 6 inches (100 mm) high.
- E. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- F. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- G. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may at any time and any number 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.

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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.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

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. Modular carpet tile.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color and dye lot.

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3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location and direction.
7. Pile direction.
8. Type, color and location of insets and borders.
9. Type, color and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.9 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Warranty cannot require a proprietary cleaning process.
 - 3. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 4. Warranty Period: 20 years from date of Substantial Completion.
- B. Installer Warranty: Submit Installer's warranty, signed by Installer, covering the Work of this Section for the following warranty period:
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT-1, CPT-2, & CPT-3)

- A. Basis of Design: Tile carpeting is based on Lichen Community as manufactured by Mohawk Group. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. Shaw Contract
 - 2. Milliken

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- B. Color and Pattern: As indicated in the Finish Legend on the drawings.
- C. Fiber Type: Duracolor Tricolor Premium Nylon.
- D. Surface Appearance: Textured patterned multi-colored loop.
- E. Dye Method: Solution dyed.
- F. Pile Height: 0.133.
- G. Density: 6496 (F10) and 6766 (F30 & F40).
- H. Pile Thickness: 0.133.
- I. Gauge: 1/12 (47.00 rows per 10 cm).
- J. Backing: Ecoflex One.
- K. Secondary Backing: Manufacturer's standard material.
- L. Size: 12 by 36 inches (304 by 914 mm).
- M. Installation Method: Ashlar.
- N. Applied Treatments:
 - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
 - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

2.2 WALK-OFF CARPET TILE (WOC-1)

- A. Basis of Design: Tile carpeting is based on Tuff Stuff II as manufactured by Mohawk Group. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. Shaw Contract.
 - 2. Milliken.
- B. Color and Pattern: As indicated in the Finish Schedule on the drawings.
- C. Size: 24 by 24 inches (608 by 608 mm).
- D. Installation Method: Monolithic.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

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- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
- C. Metal Edge/Transition Strips: Extruded aluminum with profile and width indicated, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
 - 1. Edge Ramps: Schluter Reno and Vinpro.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level

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cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Maintain dye-lot integrity. Do not mix dye lots in same area.
- C. Maintain pile-direction patterns as approved by the Architect.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 098433 - SOUND-ABSORBING WALL UNITS

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 shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Acoustical wall panels.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include plans, elevations, sections and mounting devices and details.
 - 2. Include details at panel head, base, joints and corners and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
 - 3. Include details at cutouts and penetrations for other work.
- C. Samples for Verification: For the following products:
 - 1. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.
 - 2. Core Material: 12-inch- (300-mm-) square Sample at corner.
 - 3. Mounting Devices: Full-size Samples.

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4. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
 1. Build mockup of typical wall area 48 inches (1200 mm) wide by full height.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Warping of core.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.
- B. Basis of Design: Sound absorbing wall units AWP-1 is based on Wallscape as manufactured by Turf and AWP-2 is based on Feltworks as manufactured by Armstrong World Industries. Subject to compliance with requirements, provide the named products or comparable products submitted and approved in accordance with Division 1 requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 1. Fire Rating: Class A.

2.3 SOUND-ABSORBING WALL UNITS

- A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges and back edge border of core.
 1. Panel Shape: As indicated on Drawings.
 2. Panel Size: 12 by 12 inches (305 by 305 mm).
 3. Mounting: Liquid nails LN-903.
 4. Edge Construction: Manufacturer's standard.
 5. Edge Profile: Square.
 6. Corner Detail in Elevation: Square with continuous edge profile indicated.
 7. Reveals between Panels: As indicated on Drawings.
 8. Facing Material: As selected by the Architect from manufacturer's full range.
 9. Acoustical Performance: Sound absorption NRC of 0.55.
 10. Nominal Thickness: Manufacturer's standard.

2.4 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
- C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
 - 1. Thickness.
 - 2. Edge straightness.
 - 3. Overall length and width.
 - 4. Squareness from corner to corner.
 - 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain as indicated on Drawings.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm) in 48 inches (1200 mm), noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch (1.6-mm).

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3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

SECTION 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:
 - 1. Primers.
 - 2. Water-based finish coatings.
 - 3. Floor sealers and paints.
- B. Related Requirements:
 - 1. Section 099300 "Staining and Transparent Finishing" for wood stains.
 - 2. Section 099600 "High-Performance Coatings" for high-performance coatings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. 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. Use designations indicated on drawings.
 - 4. Label each Sample for location and application area.
- C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.
- D. Paint System Schedule:
 - 1. Provide a schedule of each paint system, including substrate, and all coats. Organize by substrate.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 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 of 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. Source Limitations: Obtain each paint product from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore.
 - 2. PPG Industries, Inc.
 - 3. Sherwin-Williams.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 - 3. Products shall be of same manufacturer for each coat in a coating system.
- B. Colors: See Finish Legend.

2.3 PRIMERS

- A. Interior/Exterior Latex Block Filler: Water-based, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.
- B. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

2.4 WATER-BASED FINISH COATS

- A. Interior, Latex, Eggshell: Low-Odor/VOC paint. Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.
 - 1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.
- B. Interior, Latex, Semigloss: Low-Odor/VOC paint. Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.

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1. Gloss Level: Manufacturer's standard semigloss finish.
- C. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
1. Gloss and Sheen Level: Manufacturer's standard flat finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
 5. Gypsum Board: 12 percent.
 6. Plaster: 12 percent.
- C. 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 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.

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- 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. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. 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.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer[.]SSPC-SP 7/NACE No. 4 permits tight residues of rust, mill scale, and coatings to remain. Be aware that blast-cleaning methods may not be practical for use at Project site and may not be allowed by authorities having jurisdiction.
- G. 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.
- H. 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.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. 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.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 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.

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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. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Plastic conduit.
 - f. Tanks that do not have factory-applied final finishes.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint the following work where exposed in occupied spaces:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Plastic conduit.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Other items as directed by Architect.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing

and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- 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.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:
 - 1. Water-Based Concrete Floor Sealer System:
 - a. Two coats water-based concrete clear floor sealer.
- B. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Interior/exterior latex block filler.
 - b. Topcoat: Two coats interior, latex, eggshell.
- C. Gypsum Board Wall Substrates:
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Topcoat: Two coats interior, latex, eggshell.
- D. Gypsum Board Ceiling Substrates:

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1. Latex over Latex Sealer System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Topcoat: Two coats interior, latex, flat.

END OF SECTION 099123

SECTION 099300 – STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers
2. Wood stains.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wooden structure at composite decking
2. Section 061516 "Wood Roof Decking" for wood roof decks
3. Section 062013 "Exterior Finish Carpentry."
4. Section 062023 "Interior Finish Carpentry."
5. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.
6. Section 099600 "High-Performance Coatings" for transparent high-performance coatings on concrete floors and clay masonry.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 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.

C. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

D. Coating System Schedule:

1. Provide a schedule of each paint system, including substrate, and all coats. Organize by substrate.

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1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: 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. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.4 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.

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore.
 - 2. PPG Industries, Inc.
 - 3. Sherwin-Williams.

2.2 SOURCE LIMITATIONS

- A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.3 MATERIALS, GENERAL

- A. Material Compatibility:

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1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Stain Colors: As indicated in drawings.

2.4 PRIMERS

- A. Alkyd Sanding Sealer, Interior, Solvent Based, Clear: Solvent-based, quick-drying, clear, sandable alkyd sealer used on new interior wood surfaces that are to be top-coated with an alkyd varnish.

2.5 WOOD STAINS

- A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.
- B. Stain, exterior, semitransparent, for interior and exterior wood: waterborne semitransparent, pigmented stain for new exterior wood surfaces.

2.6 CLEAR TRANSPARENT VARNISH

- A. Sealer, exterior, clear, for interior and exterior wood: waterborne semitransparent, clear sealer for new exterior and interior wood surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with finish application only after unsatisfactory conditions have been corrected.

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1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- C. Interior Wood Substrates:
 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
 3. Sand surfaces exposed to view and dust off.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
 1. Use applicators and techniques suited for finish and substrate indicated.
 2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
 3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

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- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood Substrates, Wood Paneling and Running Trim:
 - 1. Moisture-Cured Clear Polyurethane over Stain System ST-1:
 - a. Stain Coat: Stain, semitransparent, for interior wood.
 - b. Topcoat (Two Coats): Varnish, polyurethane, moisture cured, gloss.

3.6 Exterior Wood Finish System Schedule

- A. Wood slat wall, bench backs
 - a. Three Coats SuperDeck Exterior Waterborne semi-transparent stain.
- B. Exposed Wood Deck, Wood structure
 - a. Three Coats SuperDeck Exterior Waterborne Clear Sealer

SECTION 099300

SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 high-performance coating systems, on the following substrates:
 - 1. Exterior Substrates:
 - a. Concrete, vertical and horizontal surfaces.
 - b. Steel.
 - c. Galvanized metal.
 - d. Wood.
 - 2. Interior Substrates:
 - a. Concrete, horizontal surfaces
 - b. Steel.
 - c. Galvanized metal.
 - d. Gypsum Board
 - e. CMU
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
 - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
 - 4. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
 - 5. Section 099123 "Interior Painting" for general field painting.
 - 6. Section 099600 "Staining and Transparent Finishing" for wood stains.

1.3 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 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. Use designations indicated on drawings.
 - 4. Label each Sample for location and application area.
- C. Product Schedule: Use same designations indicated on Drawings and in paint schedule to cross-reference paint systems specified in this Section. Include color designations.
- D. Coating System Schedule:
 - 1. Provide a schedule of each paint system, including substrate, and all coats. Organize by substrate.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

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3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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.

1.8 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings 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.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.
- B. Manufacturers: High performance coatings are based on products by the Sherwin Williams Company. Subject to compliance with requirements, provide the products indicated or comparable product from one of the following:
 1. Benjamin Moore & Co.
 2. Duron, Inc.
 3. ICI Paints, Devoe Coatings.
 4. PPG Architectural Finishes, Inc.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:

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1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

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. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

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- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. 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.
- F. 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 coatings.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

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3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Concrete, Vertical Surfaces
 - 1. Siloxane Water Repellent
 - a. 1 Coat clear siloxane water repellent
 - 1) Sherwin Williams Conflex 7% Siloxane Water Repellent
 - B. Steel Substrates:
 - 1. Pigmented Alkyd Urethane Enamel System:
 - a. Prime Coat: Alkyd anti-corrosive quick dry:
 - 1) Sherwin Williams Pro-Cryl Universal Primer B66-310 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - b. Intermediate Coat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel
 - c. Topcoat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel
- C. Masonry

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1. Pigmented Alkyd Urethane Enamel System:
 - a. Prime coat: 1 coat Pro-Industrial Heavy Duty Block Filler
 - b. Intermediate Coat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel
 - c. Topcoat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel

D. Medium Density Fiber Cement Panels

1. Pigmented Alkyd Urethane Enamel System:
 - a. Prime coat: 1 coat Loxon Masonry Primer
 - b. Intermediate Coat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel
 - c. Topcoat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel

E. Cast Iron Substrates:

1. Pigmented Polyurethane over High-Build System:
 - a. Prime Coat: Zinc-rich primer, anti-corrosive, for metal.
 - b. Intermediate Coat: High build, low gloss.
 - c. Topcoat: Polyurethane, two component, pigmented, semi-gloss.

F.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Pigmented Alkyd Urethane Enamel System:
 - a. Prime Coat: 1 coat of Pro Cry Universal Primer
 - b. Intermediate Coat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel
 - c. Topcoat: 1 coat Pro Industrial Waterbased Alkyd Urethane Enamel

B. Gypsum Board Substrates: (Toilet Walls, Indoor Work Bays Walls)

1. Pre-Catalyzed Waterbased Epoxy System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600, at 1.0 mils (0.025 mm) dry, per coat.
 - b. Intermediate Coat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.

c. Topcoat: Epoxy-modified latex, interior, eggshell:

- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.

C. Masonry Block Substrates: (Walls)

1. Pre-Catalyzed Waterbased Epoxy System:

a. Block Filler: Block filler, latex, interior/exterior:

- 1) S-W Pro Industrial Heavy Duty Block Filler, B42W150Series, at 10 mils (0.254 mm) dry, per coat.

b. Intermediate Coat: Epoxy-modified latex, interior, eggshell:

- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.

c. Topcoat: Epoxy-modified latex, interior, eggshell:

- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.

D. Exposed Ductwork

1. Pre-Catalyzed Waterbased Epoxy System:

a. Primer

- 1) S-W Pro Industrial Pro-Cryl Universal Primer

b. Intermediate Coat: Epoxy-modified latex, interior, eggshell:

- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.

c. Topcoat: Epoxy-modified latex, interior, eggshell:

- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.

END OF SECTION 099600

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dimensional characters.
 - a. Fabricated channel dimensional characters.

1.2 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 size.
- 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: Full-size Sample.
 - 2. Exposed Accessories: Full-size Sample of each accessory type.
 - 3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
- D. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify locations of blocking embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

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: Five years from date of Substantial Completion.

- B. Special Warranty on Signage Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal signs that show evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Exposed Signage Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 30 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.

- 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 (82 deg C), material surfaces.

2.2 DIMENSIONAL CHARACTERS

- A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
 - 1. Manufacturers:
 - a. Source Limitations: Obtain all dimensional signage and mounting hardware from a single manufacturer.
 - 2. Character Material: Sheet or plate aluminum.
 - 3. Material Thickness: 0.100 inch (2.54 mm).
 - 4. Character Height: 8 inches.
 - 5. Character Depth: 1 inch.
 - 6. Finishes:
 - a. Baked-Enamel or Powder-Coat Finish: Custom color to match storefront.
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
 - 7. Mounting: Projecting studs.
 - a. Hold characters at 3/8 inch distance from wall surface.
 - b. Typeface: Arial.
 - 8. Weeps: Provide weep holes to drain water at lowest part of exterior characters.

2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. 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 hot-dip galvanized devices unless otherwise indicated.

3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. 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.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. 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.

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- 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.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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 OF DIMENSIONAL CHARACTERS

- 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. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

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- a. **Masonry Substrates:** Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
- b. **Thin or Hollow Surfaces:** Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3.3 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 102117 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Solid-plastic toilet compartments.
- B. Related Requirements:
 - 1. Section 102800 "Toilet and Bath Accessories" for accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Solid-plastic toilet compartments:
 - a. Include construction details, material descriptions, dimensions of individual components and profiles and finishes for toilet compartments.
- B. Shop Drawings: For solid-plastic 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 centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
- C. Samples for Verification: Actual sample of finished products for each type of toilet compartment indicated.
 - 1. Size: Manufacturer's standard size.
 - 2. Include each type of hardware and accessory.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments.

1.4 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Department of Justice "2010 ADA Standards for Accessible Design" for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS (TC-1)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Scranton Products.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Door, Panel and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges and with homogenous color and pattern throughout thickness of material.
 - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 - 2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 - 3. Color and Pattern: As selected by Architect from manufacturer's full range.
- D. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- E. Pilaster Sleeves (Caps): Manufacturer's standard design; solid plastic or stainless steel.
 - 1. Plastic Color: Matching pilaster.
- F. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.

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- G. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories, Heavy Duty: 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. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

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- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, out-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 OF PLASTIC TOILET COMPARTMENTS

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Notching of partition structure to accommodate hardware is not acceptable.
- B. Overhead-Braced Partitions shall be secured with vandal-resistant stainless steel screws with expansion anchors at masonry and tile walls and secured to blocking at framed walls.

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- C. Units: Secure pilasters to floor and level, plumb and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.
- D. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust, so tops of doors are level with tops of pilasters when doors are in closed position.

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 102117

SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, paired panel operable partitions.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

1.2 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 REFERENCE STANDARDS

A. ASTM International

1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E84 - Surface Burning Characteristics of Building Materials.
4. ASTM E413 - Classification for Rating Sound Insulation

B. Other Standards

1. ADA – Americans with Disabilities Act

1.5 ACTION SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.

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- B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- D. Samples: Color samples demonstrating full range of finishes available. Verification samples will be available in same thickness and material indicated for the work.
- E. Reports: Provide a complete and unedited written sound test report indicating glass thickness and spacing in test specimen matches product as submitted.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.
- E. Indoor Air Quality: Operable partition, movable wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval

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guarantees conformance to indoor air concentrations meeting Indoor Advantage Gold Indoor Air Quality Certified to SCS-105 v4.2-2023 Conforms to ANSI/BIFMA M7.1 and X7.1 and the CDPH/EHLB Standard Method (CA 01350) v1.2-2017 conducted in an independent third-party air quality testing laboratory.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.9 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Warranty period: Ten (10) years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.
 - 2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C423, and rated for not less than the NRC indicated.
- B. Basis of Design: Operable Partition is based on products manufactured by ModernFold. Subject to compliance with requirements. Provide the named products or comparable products by one of the following:
 - 1. Advanced Equipment Corporation: #3Mc64U52.

2.2 OPERABLE ACOUSTICAL PANELS

- A. OP-01: Acousti-Seal Encore Microperf™ – Paired Panel: Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals and automatic top seals.
- B. Final Closure:

1. OP-01: Horizontally expanding panel edge with removable crank

2.3 PANEL CONSTRUCTION

- A. Nominal 4-1/4-inch (108mm) thick panels in manufacturer's standard 51-inch (1295mm) widths. All panel horizontal and vertical framing members shall be fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin. Aluminum materials are not acceptable in any construction of the panels. All materials must be a minimum of 16 gauge formed steel. Assembly must be fully welded, adhesives and/or fasteners are not permitted nor acceptable.
 1. Panel skin shall be:
 - a. OP-01: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Steel skins which are not lock formed and welded to the steel frame are not acceptable. Acoustical ratings of panels with this construction minimum:
 - 1) 51 STC - 21-gage steel
 - 2) .95 NRC – 16-gage steel
 2. Hinges for Panels, Pass Doors, and Pocket Doors shall be:
 - a. OP-01: Concealed laminated hinge with antifriction segments mounted between each heat-treated link. Hinge to be attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Lifetime Warranty on hinges. Concealed hinges mounted into panel edge or vertical astragal are not acceptable.
 3. Panel Trim: No vertical or horizontal trim required or allowed on edges of panels; minimal groove appearance at panel joints.
 4. Panel Weights:
 - a. OP-01: 51 STC - 9.5 lbs./square foot

2.4 PANEL FINISH

- A. Panel finish shall be factory applied, Class "A" rated material. Finish shall be:
 1. OP-01: Momentum Felt. Panel finish material must be approved by panel manufacturer.
 - a. Color: See Finish schedule
- B. Panel Trim: Exposed panel trim of one consistent color:
 1. OP-01: As selected by Architect from full range.

2.5 SEALS

- A. Vertical Interlocking Sound Seals between panels: Aluminum astragals, with tongue and groove configuration in each panel edge. Rigid plastic astragals are not acceptable.
- B. Horizontal Top Seals shall be Manufacturer Standard automatic operable top seals, manually operated top seals not required or permitted.
- C. Horizontal bottom floor seals shall be Manufacturer Standard bottom seal:
 - 1. OP-01: SM2 - Manually activated seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to -1-1/2-inch (38 mm). Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds (54 kg) downward force to the floor throughout operating range.

2.6 SUSPENSION SYSTEMS

- A. OP-01: #17 Suspension System
 - 1. Suspension Tracks: Minimum 11-gauge, 0.12-inch (3.04 mm) roll-formed steel. Track shall be supported by adjustable steel hanger brackets connected to structural support by pairs of 3/8-inch (9.5 mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
 - a. Exposed track soffit: Steel, integral to track, and pre-painted off-white.
- B. Carriers: One all-steel trolleys with steel-tired ball bearing wheels. Non-steel tires are not acceptable.
 - 1. Warranty period: Ten (10) years.
- C. Basis Of Design (OP-01): Modernfold Truss System – Pre-fabricated, all steel, self-supporting header system for the support of operable partitions. Aluminum structural support systems not acceptable. (For complete specification, see Modernfold Truss System section).
 - 1. Components
 - a. Truss components shall be factory fabricated of steel; aluminum components are not acceptable. Modernfold Truss System is attached to the building structure for lateral support only. The load of the truss and partition is supported by the column support tubes.
 - b. Base End Tube and I-Beam Sections. Bolt together truss has steel tube and steel I-beam sections with integral track attachments points. Aluminum truss, tube, and/or I-beam components are not acceptable.
 - c. Column Support Tubes. Column support tubes shall be 3" x 3" (76 mm x 76 mm) steel tubing; aluminum components are not acceptable. Column support tubes shall be attached to the truss with steel brackets and bolts. Column support tubes shall be anchored to the floor with concealed fasteners utilizing a base plate limits the direct load on the floor to 575 psi maximum.
 - d. Truss bracing provides operational stability to the Modernfold Truss System and shall be set at each column support tube and centered in each

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- I-beam section. Blocking for truss bracing to be provided by others in accordance with the plans.
2. Modernfold Truss System as manufactured by Modernfold, Inc.
 - a. The truss is to be shipped in sections and assembled on site for custom assembly which meets site conditions. Maximum weight of any component should not exceed 300 pounds. Pre-assembled truss systems are not acceptable.
 3. Options and Accessories
 - a. Optional Base plate. Base Plate for each Column Support Tube limits the direct load on the floor to:
 - b. OP-01: 575 psi maximum (standard base plate)
 4. Warranty period: Ten (10) years.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
- B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

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3.4 PREVENTATIVE MAINTENANCE

- A. Provide for a coordinated preventative maintenance program which shall be provided by an authorized service provider of the manufacturer of operable partition with a minimum of (10) years' experience. The maintenance schedule shall be provided quarterly for a (1) year period and renewable.

3.5 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.6 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION 102239

SECTION 102800 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Washroom accessories.
2. Shower accessories.
3. Hand dryers.
4. Childcare accessories.
5. Underlavatory guards.
6. Custodial accessories.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Samples: For each exposed product and for each finish specified, full size.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

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1.4 CLOSEOUT SUBMITTALS

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

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.
 - 2. Shower Seats: Installed units are able to resist 250 lbf (1112 N) applied in any direction and at any point.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.

2.3 WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser (TTH):
 - 1. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.

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2. Mounting: Surface mounted.
3. Operation: Controlled delivery.
4. Capacity: Designed for 5-inch- (127-mm-) diameter tissue rolls.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Paper Towel (Folded) Dispenser (PT)

1. Mounting: Recessed.
2. Minimum Capacity: 400 C-fold or 525 multifold towels.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
4. Lockset: Tumbler type.
5. Refill Indicator: Pierced slots at sides or front.

D. Trash Receptacle (TR):

1. Mounting: Surface mounted.
2. Minimum Capacity: 4 gal. (15 L).
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
4. Liner: Reusable vinyl liner.

E. Combination Towel (Folded) Dispenser/Waste Receptacle: (CMB)

1. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
2. Mounting: Recessed with projecting receptacle.
 - a. Designed for nominal 4-inch (100-mm) wall depth.
3. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
4. Minimum Waste-Receptacle Capacity: 4 gal. (15 L).
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

F. Soap Dispenser: (SD)

1. Description: Designed for manual operation and dispensing soap in liquid form.
2. Mounting: Horizontally oriented, surface mounted.
3. Capacity: 40 oz.
4. Materials: Stainless steel.
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.

G. Grab Bar: (GBxx)

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

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3. Outside Diameter: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings.

H. Sanitary-Napkin Disposal Unit: (SND)

1. Mounting: Surface mounted.
2. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
3. Receptacle: Removable.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

I. Mirror Unit: (MI. MI-2 & FHM)

1. Frame: Stainless steel channel.
 - a. Corners (MI): Manufacturer's standard.
2. Size: As indicated on Drawings.
3. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

J. Coat Hook: (CH)

1. Description: Single-prong unit.
2. Mounting: Concealed.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.4 SHOWER ACCESSORIES

A. Source Limitations: Obtain each type of public-use shower room accessory from single source from single manufacturer.

B. Shower Curtain Rod: (SR)

1. Description: 1-inch- (25.4-mm-) outside diameter, straight rod.
2. Configuration: As indicated on Drawings.
3. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
4. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Shower Curtain:

1. Size: Minimum 12 inches (305 mm) wider than opening by 72 inches (1829 mm) high.
2. Material: Nylon-reinforced vinyl, minimum 9 oz. (255 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial and flame-retardant agents.
3. Color: As selected by the Architect from manufacturer's full range.
4. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

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D. Folding Shower Seat: (FDS)

1. Configuration: L-shaped seat, designed for wheelchair access.
2. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
3. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
4. Dimensions: As indicated.

E. Towel Hook (TH):

1. Description: Projecting minimum of 3 inches (76 mm) from wall surface.
2. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.5 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain each type of childcare accessory from single source from single manufacturer.

B. Diaper-Changing Station: (BC)

1. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb (113-kg) static load when opened
2. Mounting: Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: HDPE in manufacturer's standard color.
5. Liner Dispenser: Provide separate dispenser for disposable sanitary liners.

C. Diaper-Changing Station Liner Dispenser:

1. Mounting: Recessed.
2. Minimum Capacity: 100 liners.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
4. Lockset: Tumbler type.

2.6 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.7 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain each type of custodial accessory from single source from single manufacturer.
- B. Custodial Mop and Broom Holder: (US)
 - 1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 - 2. Length: 36 inches (914 mm).
 - 3. Hooks: Four.
 - 4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
 - 5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.

2.8 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm-) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.9 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 in accordance with 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.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 104415 - FIRE-PROTECTION SPECIALTIES

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. Portable Fire Extinguishers
 - 2. Fire-protection cabinets for portable fire extinguishers.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

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1.6 FIRE EXTINGUISHER CERTIFICATION

- A. General: All fire extinguishers shall be inspected and tagged by a certified agency acceptable to authorities having jurisdiction. This certification is required of all fire extinguishers and shall be conducted at a time that will not delay the date of Substantial Completion.
 - 1. Upon certification of each fire extinguisher, the manufacturer's tag shall be removed and a new tag installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. JL Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Potter Roemer; Div. of Smith Industries, Inc.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.3 FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Valves: Manufacturer's standard.
 - 2. Handles and Levers: Stainless steel.
 - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- 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.

2.4 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.

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- B. Cabinet Construction: Nonrated, unless installed in fire-rated construction.
 - 1. Fire Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch (1.1-mm) thick, cold-rolled steel sheet lined with minimum 5/8-inch (16-mm) thick, fire barrier material. Provide factory drilled mounting holes.
- C. Cabinet Material: Enameled-steel sheet.
- D. Semi-recessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered break glass.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting lever handle with cam-action latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Door Lock: Cylinder lock, keyed alike to other cabinets.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated below.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- K. Finishes:
 - 1. Interior of Cabinet.
 - a. Baked enamel.

- b. Color and Texture: White.
- 2. Door and Frame:
 - a. Stainless Steel: No. 4 (satin) finish.

2.5 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.

2.7 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

2.8 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.

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1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Satin, Directional Polish: No. 4 finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for cabinets before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below.
 1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 1. Provide inside latch and lock for break-glass panels.
 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
 1. Cabinet: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

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- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104415

SECTION 105113 - METAL LOCKERS

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. Two-tiered welded lockers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections and attachment details.
 - 2. Show locker trim and accessories.
 - 3. Include locker identification system and numbering sequence.
- C. Samples for Verification: For the following products, in manufacturer's standard size:
 - 1. Lockers finish.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.6 FIELD CONDITIONS

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

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. List Industries.
 - 2. Penco Products.
 - 3. Republic Storage Products.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 TWO-TIER WELDED LOCKERS

- A. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
 - 2. Door Style: Vented panel as follows:
 - a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.
 - b. Security Vents: Manufacturer's standard, stamped horizontal or vertical.
- B. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with minimum thicknesses as follows:
 - 1. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.
 - 2. Backs: 0.048-inch (1.21-mm) nominal thickness.
 - 3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.
- C. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
- D. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 - 1. Continuous Hinges: Manufacturer's standard, steel, full height.
- E. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
 - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

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- F. Door Handle and Latch for Lockers: Stainless steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.
- G. Locks: Combination padlocks.
- H. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.
- I. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.
- J. Coat Rods: Manufacturer's standard.
- K. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
 - 1. Closures: Vertical-end type.
- L. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
- M. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - 2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- N. Finish: Powder coat.
 - 1. Color: As selected by the Architect from manufacturer's full range.

2.4 LOCKS

- A. Combination Padlock: Provided by Owner.

2.5 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves and accessories from one-piece steel sheet unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

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- C. Equipment: Provide each locker with an identification plate and the following equipment:
 - 1. Two-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks for each locker.
 - 2. Coat Rods: For each compartment of each locker.
- D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
- E. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
 - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.
- F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
- G. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.6 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors or support bases, 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lockers level, plumb and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
 - 3. Anchor back-to-back metal lockers to floor.
- B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.
- C. Equipment:
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with at least two aluminum rivets.
- D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach recess trim to recessed metal lockers with concealed clips.
 - 2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 3. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 4. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain or paint. Do not permit use during construction.

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- B. Touch up marred finishes or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 113013 - RESIDENTIAL APPLIANCES

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. Refrigeration appliances.
 - 2. Microwaves.
- B. Related Requirements:
 - 1. Section 224100 "Residential Plumbing Fixtures" for kitchen sinks, waste (garbage) disposers, and instant hot-water dispensers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.5 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

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- B. Refrigerator/Freezer, Sealed System: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
 - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
 - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.
- C. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of residential appliance from single source.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Summit
 - 2. General Electric Company (Hotpoint).
 - 3. Whirlpool Corporation.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design.

2.3 REFRIGERATOR/FREEZER (Break Room)

- A. Freestanding Refrigerator/Freezer: Freestanding refrigerator/freezer with freezer on bottom, to be furnished and installed by the Contractor.
 - 1. Basis of Design: GE Model GWE19JML/JYL.
 - 2. Type: Freestanding.
 - 3. Dimensions:
 - a. Width: 32-3/4 inches.
 - b. Depth: 31-0 inches.
 - c. Height: 70 inches.
 - 4. Storage Capacity:

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- a. Refrigeration Compartment Volume: 13.59 cu ft.
 - b. Freezer Compartment Volume: 5.02 cu ft.
- 5. General Features:
 - a. Door Configuration: As indicated.
- 6. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Door Shelves: 5 full-width glass.
 - c. Digital thermostat.
- 7. Front Panel(s): Stainless steel.
- 8. Appliance Color/Finish: Stainless steel.

2.4 REFRIGERATOR/FREEZER (Classrooms & Conference)

- A. Freestanding Refrigerator/Freezer: Freestanding refrigerator/freezer with freezer on bottom, to be furnished and installed by the Contractor.
 - 1. Basis of Design: Whirlpool Model WRT311FZD.
 - 2. Type: Freestanding.
 - 3. Dimensions:
 - a. Width: 32-3/4 inches.
 - b. Depth: 32-7/8 inches.
 - c. Height: 66-1/4 inches.
 - 4. Storage Capacity:
 - a. Refrigeration Compartment Volume: 14 cu ft.
 - b. Freezer Compartment Volume: 6 cu ft.
 - 5. General Features:
 - a. Door Configuration: As indicated.
 - 6. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Door Shelves: 3 full-width glass.
 - c. Digital thermostat.
 - 7. Front Panel(s): Stainless steel.
 - 8. Appliance Color/Finish: Stainless steel.

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- B. Undercounter Refrigerator/Freezer: One-door refrigerator with freezer compartment inside and complying with AHAM HRF-1, to be furnished and installed by the Contractor.
1. Basis of Design: Summit Model AL54.
 2. Type: Undercounter.
 3. Dimensions:
 - a. Width: 23-5/8 inches.
 - b. Depth: 22-5/8 inches.
 - c. Height: 32-0 inches.
 4. Storage Capacity:
 - a. Refrigeration Compartment Volume: 4.8 cu. ft.
 - b. Shelf Area: Three adjustable glass shelves.
 5. General Features:
 - a. Door Configuration: As indicated.
 6. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Door Shelves: 2 full width.
 - c. Digital thermostat.
 7. Front Panel(s): Stainless steel.
 8. Appliance Color/Finish: Stainless steel.

2.5 MICROWAVE OVENS

- A. Microwave Oven:
1. Basis of Design: Summit Model SMI27:
 2. Mounting: Countertop.
 3. Type: Convection.
 - a. Width: 24-3/8 inches.
 - b. Depth: 19-5/8 inches.
 - c. Height: 13-1/2 inches.
 4. Capacity: 2.2 cu. ft.
 5. Oven Door: Door with observation window and pushbutton latch release.
 6. Exhaust Fan: Manufacturer's standard.
 7. Microwave Power Rating: 1200 W.
 8. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
 9. Controls: Digital panel controls and timer display.
 10. Other Features: Turntable.

11. Material: Stainless steel.

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, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance 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 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.

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2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After installation, start units to confirm proper operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 113013

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, light-filtering window shades.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers and their relationship to adjacent work.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 3 inches (76 mm) square. Mark interior face of material if applicable.
2. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

D. Product Schedule: For roller shades. Use same room designations as indicated on the drawings.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals; methods for maintaining roller shades, precautions regarding cleaning materials and methods and instructions for operation hardware.

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1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in the section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver roller shades until construction within spaces where shades will be installed is substantially complete.
- B. Deliver and store products in manufacturer's original, unopened, undamaged containers with labels intact.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

- A. Hardware and Shade Fabric: 20 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Roller window shades are based on Urbanshade as manufactured by Mechoshade systems, Inc. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. Hunter Douglas Contract.
 - 2. Roll A Shade.

2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES

- A. Operation Type: Bead and chain clutch operated, vertical roll-up, fabric, opaque window shade system, complete with headbox, side and sill channels for total opacity.
- B. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.
 - 1. Clutch Mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester.
 - a. Bead Chain Loop: As selected by the Architect from manufacturer's full range.
 - b. Bead Chain Hold Down: Spring-loaded tensioner complying with ANSI/WCMA A100, 1-2022 safety standard.
 - 2. Idler Assembly: Provide roller idler assembly of molded nylon with adjustable length idler pin to facilitate easy installation and removal of shade for service.
- C. Roller Tube: Fabricated from extruded aluminum, galvanized steel or enameled steel. Diameter, wall thickness and material shall be selected by the manufacturer to accommodate shade type and size.
- D. Headbox: Extruded aluminum sections with endcaps and opacity plates.
 - 1. Size: 4-1/8 inches (105 mm) high by 3-1/2 inches (89 mm) wide by length required for shade being provided.
- E. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall or jamb. Provide size compatible with roller size.
- F. Side Channels: Double chamber fabricated from 0.06 inch (1.5 mm) thick extruded aluminum.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.
 - 2. Type: Woven PVC-coated fiberglass.
 - 3. Weave: Basketweave or mesh.
 - 4. Thickness and Weight: Manufacturers standard for size of shades.
 - 5. Roll Width: As indicated.
 - 6. Orientation on Shadeband: As indicated on Drawings.
 - 7. Openness Factor: 3 percent.

8. Color: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb and aligned with adjacent units according to manufacturer's written instructions.
- B. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123619 - WOOD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For wood countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in wood countertops.
3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
4. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished wood countertops.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: Fabricator of products.

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1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep finished surfaces of countertops covered with protective covering during handling and installation.

1.5 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install wood countertops until building is enclosed, wet-work is complete and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where wood countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 WOOD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood countertops indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Grade: Premium.
- C. Wood-Veneer Countertops: For stained finish. Fabricated from wood veneer laminated over panel-product core.
 - 1. Wood Species: Baltic Birch.
 - 2. Wood Cut: Plain sawn.
 - 3. Matching of Adjacent Veneer Leaves: Random.
 - 4. Veneer Matching within Panel Face: Balance match.
 - 5. Edge Treatment: Solid wood matching face for species and cut.
 - 6. Core Material: Exterior-grade plywood.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood countertop and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
 - 1. Softwood Plywood: DOC PS 1.

2.3 FABRICATION

- A. Fabricate wood countertops to dimensions, profiles and details indicated. Ease edges to radius indicated for the following:
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.4 SHOP FINISHING

- A. General: Finish wood countertops at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood countertops, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood countertops. Apply two coats to end-grain surfaces.

C. Stained Finish:

1. Grade: Premium.
2. Topcoat: System - 11, catalyzed polyurethane.
3. Staining: Match Architect's sample.
4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition wood countertops to average prevailing humidity conditions in installation areas for not less than 72 hours.
- B. Before installing wood countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and application of backpriming.

3.2 INSTALLATION

- A. Grade: Install wood countertops to comply with same grade as item to be installed.
- B. Assemble wood countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut wood countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
 2. Secure backsplashes to walls with adhesive.
 3. Seal joints between countertop and backsplash, and joints where countertop and backsplash abut walls with sealant specified in Section 079200 "Joint Sealants."

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- F. Shop Finishes: Touch up finishing after installation of wood countertops.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective wood countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean wood countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123619

SECTION 123663 – SOLID SURFACING COUNTERTOPS

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. Solid surface material countertops.
 - 2. Counter support brackets.
 - 3. Workstation dividers.
 - 4. Grommets
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for tube steel support legs.
 - 2. Section 064116 "Plastic Laminate Faced Architectural Cabinets" For cabinets under countertops.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches (150 mm) square.
 - 2. Counter support bracket.
 - 3. Workstation divider material, 6 inches (150 mm) square.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 COUNTERTOPS

- A. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with manufacturer's written instructions for adhesives, sealers, fabrication and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.2 SOLID-SURFACE-MATERIAL COUNTERTOPS (SS1)

- A. Basis of Design: Solid surface material is based on products manufactured by Wilsonart. Subject to compliance with requirements, provide the named product or comparable product by one of the following:
 - 1. Hi-Macs.
 - 2. Meganite.
- B. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: 1-1/2-inch (38-mm) laminated bullnose.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- C. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.

2.3 COUNTER SUPPORT BRACKETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & M Hardware.
 - 2. Brunswick.
 - 3. Rangine Corporation.

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- B. Locations: As indicated on the drawings.
- C. Weight Capacity: 450 lbs.
- D. Fasteners: As recommended by the manufacturer.
- E. Style and Color: As selected by the Architect from manufacturer's full range.

2.4 WORKSTATION DIVIDERS (SS2)

- A. Basis of Design: Workstation dividers are based on Varia as manufactured by 3Form.
 - 1. Thickness: 1/4-inch (6.4 mm).
 - 2. Size: As indicated on the drawings.
 - 3. Edges: 1/8" eased edge corners.
 - 4. Flame Spread: 65 per ASTM E84.
 - 5. Smoke Developed: 425 per ASTM E84.
 - 6. Color and Pattern: As selected by the Architect from manufacturer's full range.
 - 7. Mounting Method: 3Form Align Clips. Color: Black.

2.5 Grommets for Cable Passage through Countertops: Round metal, with cover.

- 1. Basis of Design: BRV-1 2-3/8" diameter desk grommet, as manufactured by Mockett or equal.
- 2. Size: 2-11/16" overall diameter, for 2-3/8" diameter hole.
- 3. Color: White.
- 4. Locations: As indicated on the drawings and to be coordinated with the Owner prior to drilling holes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION 123663

SECTION 123665 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.

B. Related Requirements:

1. Section 064116 "Plastic Laminate Faced Architectural Cabinets" for counters under cabinets.
2. Section 123663 "Solid Surfacing Countertops" For Grommets to be installed in countertops.
3. Section 224100 "Residential Plumbing Fixtures" for sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

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- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as indicated on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.6 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE MATERIALS (Q-1)

- A. Quartz Countertop:
 - 1. Basis of Design: Quartz countertops are based on products manufactured by Cambria. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - a. Corian Quartz.
 - b. Hanstone Quartz.
 - 2. Configuration: Provide countertops with the following front and backsplash style:
 - a. Fronts and Sides: Waterfall edge.
 - 3. Countertops: 3/4-inch- (2-cm) thick, quartz agglomerate with front edge built up with same material.
 - 4. Backsplashes: 3/4-inch- (2-cm) thick, quartz agglomerate material.
 - 5. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 6. Color: As indicated in the Finish Schedules on the drawings.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Premium.
- B. Countertops: 3/4-inch- (19-mm-) thick, quartz agglomerate with front edge built up with same material.
- C. Backsplashes: 3/4-inch- (19-mm-) thick, quartz agglomerate.
- D. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- E. Joints:
 - 1. Fabricate countertops without joints.
- F. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch (10-mm) radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch (5 mm) into fixture opening.
 - c. Provide 3/4-inch (20-mm) full bullnose edges projecting 3/8 inch (10 mm) into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123665

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SECTION 22 05 00 - GENERAL PLUMBING PROVISIONS

PART 1 GENERAL

1.01 SCOPE

- A. The plumbing work will include the furnishing of all plant, labor, materials, accessories, and equipment required to install a complete and fully operational plumbing system as shown, specified and/or reasonably implied for a complete project.

1.02 QUALITY ASSURANCE

- A. Refer to Division 1, Division 2 and General Conditions for Project Requirements.
- B. All work shall be in accordance with State Code and Underwriter's Regulations. Minimum requirements shall be the State Plumbing Code.
- C. Wherever the words "Approved", "Approval", or "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
- D. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
- E. Boiler Inspection Certificate (If applicable): It shall be the responsibility of the Contractor to complete the installation of fired or unfired pressure vessels and their safety devices in accordance with the requirements of the latest edition of the North Carolina Department of Labor, "Boiler Inspection Law, Rules and Regulations". The Contractor shall be responsible for notifying the Bureau of Boiler Inspection in writing at least two weeks prior to the date of completion of all equipment requiring inspection. Certificates furnished by the Bureau of Boiler Inspection shall be in a frame having a removable glass cover and posted near the pressure vessel. Certificates shall be installed before requesting final inspection of the completed project. The pressure vessel is NOT to be operated before it is inspected and approved.

1.03 SUBMITTALS

- A. See General and Supplementary General Conditions.
- B. Within ten days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit to the Architect/Engineer for approval a detailed list of equipment and material that he proposes to use. Items requiring submittal data for approval will be noted at this time.
- C. The Contractor shall provide an electronic pdf copy of the submittal data on the products, methods, etc. proposed for use on the project. The submittal shall contain complete submittal data on all products, methods, etc. proposed for use on the project.

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- D. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog numbers, and all necessary performance and fabrication data.
- E. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all
- F. The Contractor shall furnish an electronic copy of maintenance and operating instructions as outlined in Paragraph C, Execution, Item #7, of this specification section.
- G. The Contractor shall submit to the Owner all certificates required for operating the system in compliance with the plans and specifications.

1.04 COORDINATION OF WORK

- A. The General Contractor shall be responsible for coordination between various Subcontractors. Whenever interference might occur between the plumbing work and the work of other trades, the Plumbing Contractor shall consult with the General Contractor before installing any of the work in question. When it appears that a departure from the Plans is necessary due to actual field conditions or other causes, detailed drawings shall be prepared for submittal to the Architect for approval. The Architect shall make final decision as to any conditions which require changing the work.
- B. The Contractor shall review the electrical plans to establish points of connection and the extent of electrical work to be provided in his Contract. All electrical work shall be performed by a licensed electrician.
- C. This Contractor shall be responsible for the final electrical connections to all equipment installed as part of his Contract.
- D. Electrical work shall be in accordance with State codes, and as specified in Division 26 contained herein.
- E. Pipe, conduit and duct chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.
- F. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.

1.05 FEES, PERMITS AND INSPECTIONS

- A. Plumbing Contractor shall obtain permits and arrange all inspections necessary for the installation of his work, paying all fees in connection therewith, and furnishing the Architect with certificates of inspection from all authorities having jurisdiction.
- B. Inspections and tests shall be made upon formal notice to the Architect from the Contractor sufficiently in advance to allow a representative of the Architect to be present for each test.

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- C. No piping or other construction shall be covered up or concealed until it has been inspected or approved. The Contractor shall furnish all material, labor, fuel, equipment and apparatus, and bear all expenses of such tests as are hereinafter specified for the work.

1.06 CODES AND STANDARDS

- A. The applicable provisions of the following codes and standards, each of the latest issues, and all addenda thereto shall form a part of these specifications.
- B. North Carolina Building Codes (which includes the National Electrical Code).
- C. North Carolina Boiler Inspection Law, Rules, and Regulations, latest issue.
- D. Underwriters' Laboratories, ASTM, ASME, NEMA, ANSI, and other Standards as specifically referred to in these specifications.

1.07 GUARANTEE

- A. See the General and Supplementary General Conditions.
- B. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Architect/Engineer.

1.08 TEMPORARY UTILITY SERVICES

- A. Temporary utilities shall be provided in accordance with General Conditions.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. Equipment and materials entering into the permanent work shall be new and shall bear the manufacturer's name or trade name. All water consuming devices shall be the water saving type. In every case where a standard has been established by the Underwriters' Laboratories for a particular material, such material shall bear UL label. Equipment and material of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
- B. Piping, fittings and valves in connection with semi-permanent plumbing fixtures and temporary water outlets shall be as specified for similar items in the permanent work under Section titled "Plumbing Pipe" when fixtures are set in the permanent structure. Should the Contractor elect to construct a temporary structure to contain toilets for the use of workmen, the piping, valves and fittings may be of materials of the Contractor's selection provided they are completely removed from the project when no longer in use.
- C. Plumbing fixtures for use in semi-permanent toilets may be approved second-hand items which will meet the requirements of the North Carolina State Plumbing Code. Such fixtures shall be completely removed from the project when no longer in use.

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2.02 DIMENSIONS

- A. The Plumbing Contractor shall be responsible for insuring that items of equipment furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those of connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications.

2.03 MANUFACTURER'S DIRECTIONS

- A. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions, and shall obtain the Architect's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Architect, he shall bear all costs arising in correcting the deficiencies.

2.04 EQUIPMENT ACCESSORIES

- A. The Plumbing Contractor shall provide all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner.

2.05 SUBCONTRACTORS AND MATERIALS LIST

- A. The Plumbing Contractor shall, within the requirements of the General Conditions, submit to the Architect, in triplicate, a complete list of Sub contractors and materials he proposes to use in the work. Materials list shall include manufacturer's name of specific items of material proposed.

2.06 SHOP DRAWINGS AND CATALOG DATA

- A. The Plumbing Contractor shall submit shop drawings and catalog cuts of all pieces of equipment to the Architect for approval. The Plumbing Contractor shall submit the number of copies as required by the General Conditions. Approval of the Architect of shop drawings for any materials, apparatus, devices, and layouts shall not relieve this Contractor from the responsibility of furnishing same of proper dimensions, size, quantity, quality, and all performance characteristics to efficiently perform the requirements and intent of the Contract Documents. Such approval shall not relieve this Contractor from responsibility for errors of any sort on the shop drawings. If the shop drawings deviate from the Contract Documents, this Contractor shall advise the Architect of the deviations in writing accompanying the shop drawings, including the reason for deviations.
- B. Any items found on the job either installed or not installed which do not meet the above criteria shall be replaced by the Contractor at the discretion of the Engineer. Review and stamp all shop drawings submittals before submitting them to the Engineer for approval. Any submittals not stamped and signed by the contractor prior to submittal to the Engineer will be returned to the Contractor for his stamp and resubmittal. A copy of the approved shop drawings shall be maintained on the project site at all times.

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2.07 SUBSTITUTIONS

- A. Engineer will consider requests for Substitutions in accordance with Division 1 of this specification.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds that quality level of the specified product.
 - 2. Will provide the same warranty for the Substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitutions Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 - 3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 3 EXECUTION

3.01 SUPERVISION

- A. The Contractor shall have a thoroughly competent superintendent in charge of the construction work at all times. The superintendent shall have extensive experience in the work to be performed.

3.02 MATERIALS AND WORKMANSHIP

- A. All materials and workmanship shall comply with all applicable codes, specifications, state and local ordinances, industry standards and utility company regulations.

3.03 LOCATION OF PIPES, FIXTURES, EQUIPMENT AND APPURTENANCES

- A. Location of pipes, fixtures, equipment and appurtenances shall be adjusted to accommodate the work to interferences anticipated and encountered.
- B. Install all equipment to provide minimum clearances per manufacturer's instructions around each piece of equipment.

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- C. The Contractor shall furnish and install as shown on the drawings, or as necessary to complete the working systems in accordance with the intent of the drawings and specifications, complete systems of piping, all valves as indicated or as necessary to completely control the entire apparatus and all appurtenances. The piping drawings are diagrammatic and indicate the general location and connections. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the Contractor from providing the necessary valves, fittings, and accessories to meet the conditions and the responsibility for the proper erection of systems of piping in every respect suitable for the work as described in the specification and approved by the Architect.

3.04 INSTALLATION

- A. All work shall be performed in a manner indicating proficiency in the trade.
- B. All conduit, pipes, ducts, etc. shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
- C. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
- D. All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.
- E. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish all sleeves to the General Contractor for openings through poured masonry floors or walls, above grade, required for passage of all conduits, pipes, or ducts required to support his equipment.
- F. All fixtures shall be accurately roughed in according to the manufacturer's installation dimensions so that no offset adapters, flexible connections or other improvisations are necessary. All incorrect work shall be torn out and corrected and walls and floors patched.
- G. Horizontal drainage and waste pipe shall have a minimum slope or fall of 1/8 inch per foot. All change of horizontal directions in soil waste pipe shall be made with long radius fittings with "Y" branches and 1/8 or 1/16 bends.
- H. All fixtures, floor drains, flush valves and traps shall be set plumb and level.
- I. Connections to cold water, soil and waste lines shall be made at locations shown on the Drawings.
- J. All material and equipment shall be installed following the manufacturer's installation directions.
- K. Spray-on Fireproofing overspray shall be removed from all materials provided as part of the plumbing contract.
- L. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.

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- M. Rock excavation shall be defined in the Supplementary General Conditions, Division 1 or Division 2. A unit price for each rock excavation shall be required in the bid. Plumbing Contractor shall provide the unit price per cubic yard for rock excavation. Construction Manager will establish an allowance for trench rock.

3.05 BUILDING AND FINISHES

- A. Building and finishes shall be protected. The Contractor will be held responsible for damage incurred and shall repair all damage done.

3.06 INSTALLATION OF SEMI-PERMANENT TOILET FACILITIES

- A. Piping, valves, fittings and appurtenances shall be in accordance with Sections titled "Plumbing Pipe".
- B. Plumbing fixtures shall be installed in accordance with Section titled "Plumbing Fixtures".

3.07 SUPPORTS

- A. The Contractor shall support plumb, rigid and true to line all work and equipment installed under this Contract. The Contractor shall thoroughly study all general, structural, heating, cooling and ventilating, and electrical drawings, shop drawings, and catalog data to determine how equipment, accessories, piping, fixtures, and related items are to be supported, mounted, or suspended. He shall provide all bolts, inserts, pipe stands, brackets, structural supports, and accessories for proper support whether or not shown on the drawings.

3.08 MAINTENANCE AND OPERATING MANUAL

- A. The Contractor shall prepare an electronic submission of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:
 - 1. Data on all equipment as listed on the fixture and equipment schedules on the plans, including but not limited to model numbers, input and output capacities, and selected options for each piece of equipment.
 - 2. Manufacturer's operation and maintenance manuals for each piece of equipment furnished as part of this project, and including but not limited to a check list for periodic maintenance of all equipment.
 - 3. A check list for seasonal shutdown.
 - 4. Maintenance and spare parts data for all equipment.
 - 5. As-Built wiring and control diagrams for equipment containing these.
 - 6. Name and address and phone number of at least one service agency for each piece of equipment.
 - 7. A complete narrative of how each system is intended to operate.
 - 8. Name and address of designer of record, contractors, subcontractors, and equipment suppliers.
- B. The manuals shall be dated and signed by the Contractor when completed.
- C. The operating and maintenance manuals shall be submitted to the Engineer for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

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3.09 RECORD DRAWINGS

- A. Record Drawings shall be provided in accordance with Division 1.
- B. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings. Mark the set in red to show the actual installation where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
- C. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.
- D. Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.
- E. Note related Change Order numbers where applicable.
- F. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
- G. Upon completion of mark-up, submit complete set of record documents to Designer for the Owner's records.

3.10 TEST REPORTS

- A. All systems are required to be tested and shall be documented as follows:
 - 1. Documented in writing listing date, item tested, section tested, witnesses to the test (signed) and specification section which requires testing.
 - 2. Reports to testing shall be provided to the Architect within seven (7) days of completion of each test.
 - 3. All backflow preventers shall be tested, with copies of test reports to be included in O & M manuals.
- B. The Contractor shall conform to the requirements of Division 03 for concrete testing.

3.11 CLEANING AND PAINTING

- A. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
- B. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for intended service. In no event shall nameplates be painted.
- C. All field painting of plumbing work, with exception of touch-up paint on factory finished equipment, shall be in accordance with the "Painting" section of these specifications. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat and shall be repainted if necessary.

3.12 FIRESTOPPING

- A. Firestopping shall be installed by Plumbing Contractor under provisions of Section 07270 and as detailed on drawings.
- B. The Plumbing Contractor shall be responsible for firestopping all partitions, walls and floor penetration resulting from his work. Penetrations shall be firestopped to meet or exceed rating of wall or floor systems as required by code.

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3.13 FREEZE PROTECTION

- A. Provide positive freeze protection on all water lines subject to freezing conditions.

3.14 DEMONSTRATION OF PROPER INSTALLATION BY PLUMBING CONTRACTOR

- A. Upon substantial completion and before Owner acceptance, rod and clean out each sanitary and storm system.
- B. The Plumbing Contractor shall demonstrate at final inspection that all floor drains work and adequately drain the area they serve.

END OF SECTION 22 05 00

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SECTION 22 05 01 - DIVISION OF WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. This section delineates the division of work between Divisions 22 (Plumbing) and Division 26 (Electrical).
- B. All other work necessary for the operation of Division 22 equipment shall be performed under Divisions 22.
- C. All individual motor starters and drives for fire protection equipment (pumps, etc.) shall be furnished and installed under Division 22 unless indicated as a part of a motor control center. Motor starters provided in motor control centers and at motor control troughs shall be furnished under Divisions 26.
- D. Under Division 26, power wiring rough-in shall be provided for junction box, trough, starter or disconnect switch, as required by the specific piece of equipment. Equipment final connections shall be provided under Division 22.
- E. Equipment less than 110 volt, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches, beyond termination point, and other appurtenances under Divisions 22 shall be furnished, installed and wired under Divisions 22 in accordance with Division 26.
- F. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 21.

END OF SECTION 22 05 01

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SECTION 22 05 09 - ELECTRICAL WORK

PART 1 GENERAL

1.01 DIVISION OF WORK

- A. This Contractor shall be responsible for the final electrical and the entire control connections and wiring to all equipment installed as part of his contract.
- B. Contractor shall review the electrical plans, where applicable, to establish points of connection and the extent of his electrical work to be provided in his contract.
- C. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Plumbing Contractor or as required by the existing conditions.
- D. All power and control wiring shall be in conduits. Refer to electrical specifications for conduit and conduit fittings.
- E. All electrical work shall be performed by a licensed electrician.
- F. All electrical work shall be in accordance with the State Building Code and all its supplements, the latest edition of the National Electrical Code and the electrical specifications.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.
- B. All motors shall be premium efficiency rating according to 10 CFR Part 431 published by the US Dept of Energy. Appropriate acknowledgement of compliance as required by the regulation shall be stamped on the nameplate.
- C. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.
- D. All conductors and conduits shall be sized as noted on the plans or as required per NEC.
- E. All individual motor starters for plumbing equipment (i.e., fans, pumps, etc.) shall be furnished and installed under Division 22.
- F. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break- glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 22 shall be furnished, installed and wired under Division 22.
- G. "Built-in" disconnect switches shall be installed in a NEMA 3R enclosure, it must be appropriately horsepower rated, and it must be third-party listed for the application.

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PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.
- B. Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid-Tite" conduit. Connection to other equipment shall be made with rigid conduit.
- C. Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

END OF SECTION 22 05 09

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SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.

1.02 REFERENCE STANDARDS

- A. NEMA MG 00001 - Motors and Generators; 2024.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.

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- B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- C. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 22 05 13

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SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Pipe loops, offsets, and swing joints.

1.02 REFERENCE STANDARDS

- A. EJMA (STDS) - EJMA Standards; Eleventh Edition.
- B. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- D. Maintenance Data: Include adjustment instructions.
- E. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company: www.metraflex.com/#sle.
- B. Inner Hose: Stainless steel.
- C. Exterior Sleeve: Double braided, stainless steel.
- D. Pressure Rating: 200 psi up to 6 inch.
- E. Size: Use pipe sized units.
- F. Maximum offset: 3/4 inch on each side of installed center line.

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2.03 EXPANSION LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex Ke-Loop: www.kelcoind.com/#sle.
 - 2. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc; V-Loop: www.unisource-mfg.com/#sle.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- C. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure.
- D. Maximum Working Pressure: 150 psi at 800 degrees F.
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment.
 - 1. Selected Product to Accommodate:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 2. Provide necessary accessories including, but not limited to, swivel joints.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION 22 05 16

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SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
 - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
 - 2. GPT Industries - LinkSeal.
 - 3. EJ Prescott

- B. Vertical Piping:

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1. Provide schedule 40 steel sleeve.
 2. Sleeve Length: 2 inch above finished floor.
 3. Provide silicone sealant for watertight joint when not a rated penetration.
 4. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 5. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. Pipe passing through interior walls and/or non-rated partitions
1. Schedule 40 steel sleeve. Pack opening with mineral wool.
- D. Pipe Passing Through Below Grade Exterior Walls:
1. Zinc coated or cast iron pipe.
 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Clearances:
1. Provide allowance for insulated piping.
 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Manufacturers:
1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
 2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.
 3. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
 4. GPT Industries - LinkSeal..
 5. Metraflex.
- B. Modular Mechanical Sleeve-Seal:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance with service requirements.
 4. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.

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PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Structural Considerations: Do not penetrate building structural members unless indicated.
- E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- F. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 22 05 17

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SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges.
- B. Thermometers.
- C. Pressure-temperature test plugs.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements. for additional provisions.
 - 2. Extra Pressure Gauges: One of each type and size.

1.04 ENVIRONMENTAL REQUIREMENTS

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
 - 3. Omega Engineering a subsidiary of Spectris, Plc; : www.omega.com/#sle.
 - 4. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
 - 5. Ametek, U.S. Gauge Div..
 - 6. Palmer Instruments.
- B. Bourdon Tube for Liquids and Gases:
 - 1. Dial Size and Cover: 4-1/2 inch diameter scale with polycarbonate window.

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2. Dial Text and Markings: Black color on white background with scaled psi units.
3. Accuracy: ASME B40.100, adjustable industrial grade (A) with 1 percent at mid-range of span.
4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.

C. Accessories:

1. Gauge Cock: Brass with tee or lever handle for maximum 150 psi.
2. Needle Valve: Stainless steel, 1/4 inch NPT female for noncorrosive service.
3. Coil Siphon: Stainless steel, 1/4 inch NPT male for rated capacity.

2.02 THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
3. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
4. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

B. General:

1. Product Compliance: ASTM E1.
2. Lens: Clear glass, except where stated.
3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
5. Support Socket: Brass separate sockets for thermometer stems with or without extensions as required, and with cap and chain.

- #### C. Thermometers - Adjustable Angle: 9 inch v-shape aluminum case with clear glass window scale, 3-1/2 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

2.03 PRESSURE-TEMPERATURE TEST PLUGS:

- #### A. Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.
- #### B. Wetted Materials per Temperature Range:
1. Up to 200 degrees F: Brass probe with neoprene core.
 2. 200 to 350 degrees F: Brass probe with EPDM core.
- #### C. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch diameter pressure gauges, adapters, two 1/8 inch probes, and 1 inch dual-scale dial thermometers.

PART 3 EXECUTION

3.01 EXAMINATION

- #### A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.02 INSTALLATION

- #### A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.

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- B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.
- C. Install pressure gauges as follows:
 - 1. At Pumps: Place single gauge before strainer, suction side and discharge side.
 - 2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
 - 3. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
 - 4. Install gauges in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Install thermometers as follows:
 - 1. Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
 - 2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch to accommodate sockets. Ensure sockets are above insulation clearance.
 - 3. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
 - 4. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.
 - 5. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Locate PT (pressure-temperature) test plugs adjacent to control device sockets.

END OF SECTION 22 05 19

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SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Gate valves.
- F. Globe valves.
- G. Lubricated plug valves.

1.02 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PFA: Perfluoroalkoxy alkane.
- G. PTFE: Polytetrafluoroethylene.
- H. RS: Rising stem.
- I. TFE: Tetrafluoroethylene.
- J. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2026.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- G. ASME B31.9 - Building Services Piping; 2025.
- H. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

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- I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- J. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2024, with Editorial Revision (2025).
- K. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- L. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- M. AWWA C606 - Grooved and Shouldered Joints; 2022.
- N. MSS SP-45 - Drain and Bypass Connections; 2020.
- O. MSS SP-67 - Butterfly Valves; 2022.
- P. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- Q. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- R. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- S. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- T. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- U. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- V. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- W. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than 10 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

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1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 2. Protect valve parts exposed to piped medium against rust and corrosion.
 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 5. Secure check valves in either the closed position or open position.
 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- 1.07 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:
- A. Handle large valves with sling, modified to avoid damage to exposed parts.
 - B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 1. Shutoff: Ball, butterfly, plug.
 2. Throttling: Provide ball or butterfly.
 3. Swing Check (Pump Outlet):
 - a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 inch and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
 - c. 2-1/2 inch and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- D. Required Valve End Connections for Non-Wafer Types:
 1. Steel Pipe:
 - a. 2 inch and Smaller: Threaded ends.
 - b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 inch and Larger: Grooved or flanged ends.
 - d. Grooved-End Copper Tubing and Steel Piping: Grooved.
 2. Copper Tube:
 - a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

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- b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 inch and Larger: Grooved or flanged ends.
- E. Domestic, Hot and Cold Water Valves:
 - 1. Balancing Valves (circuit setters) for Hot Water Recirculation shall be Thermostatic Balancing Valves with Service/Shutoff Ball Valves at either end, inline strainer, and T&P Ports on either side of valve such as Circuit Solver by ThermOmegaTech Model CSUAS or approved equal.
 - 2. 2 inch and Smaller:
 - a. Bronze and Brass: Provide with solder-joint ends.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
 - 3. 2-1/2 inch and Larger:
 - a. Iron, 2-1/2 inch to 4 inch: Provide with threaded or flanged ends.
 - b. Iron Ball: Class 150.
 - c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
 - d. Iron Grooved-End Butterfly: 175 CWP.
 - e. Iron Swing Check: Class 125, metal seats.
 - f. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - g. Iron Grooved-End Swing Check: 300 CWP.
 - h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - i. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - j. Iron Gate: Class 125, NRS.
 - k. Iron Globe: Class 125.
- F. Sanitary Waste, Storm Drainage, and Forced-Main Piping Water Valves:
 - 1. 2 inch and Smaller:
 - a. Bronze and Brass: Provide with solder-joint.
 - b. Bronze Angle: Class 125, bronze disc.
 - c. Ball: One piece, full port, brass with brass trim.
 - d. Bronze Swing Check: Class 125, bronze disc.
 - e. Bronze Gate: Class 125, NRS.
 - f. Bronze Globe: Class 125, bronze disc.
 - 2. 2-1/2 inch and Larger:
 - a. Iron, 2-1/2 inch to 4 inch: Provide with threaded ends.
 - b. Iron Ball: Class 150.
 - c. Iron Swing Check: Class 125, metal seats.
 - d. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - e. Iron Grooved-End Swing Check: 300 CWP.
 - f. Iron Gate: Class 125, NRS.
 - g. Iron Globe: Class 125.
 - h. Lubricated Plug: Class 125, regular gland.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.

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- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 inch and smaller except plug valves.
 - 4. Wrench: Plug valves with square heads.
- D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
 - 1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 2. Butterfly Valves: Extended neck.
 - 3. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
 - 1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 - 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

- A. Class 125; CWP Rating: 200 psi:
 - 1. Comply with MSS SP-80, Type 1.
 - 2. CWP Rating: 200 psi.
 - 3. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 4. End Connections: Pipe thread.
 - 5. Stem: Bronze.
 - 6. Disc: Bronze.
 - 7. Packing: Asbestos free.
 - 8. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim and Female Thread, Male thread, or Solder Connections:
 - 1. Comply with MSS SP-110.
 - 2. WSP Rating: 150 psi.
 - 3. WOG Rating: 600 psi.
 - 4. Body: Forged brass.
 - 5. Seats: PTFE or TFE.

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6. Stem: Stainless Steel.
7. Ball: Chrome-plated brass.
8. Cap: Include cap-gasket and chain for 3/4 inch hose connection.
9. Operator: Lockable handle and memory stop.

2.05 STAINLESS STEEL, BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP Rating: 2,000 psi.
 4. Seats: PTFE.
 5. Stem: Stainless steel, blowout proof.
 6. Ball: Stainless steel, vented.
 7. End Connections: Threaded.
 8. Operator: Lockable handle.

2.06 IRON, BALL VALVES

- A. Split Body, Full Port, Flanged:
 1. Comply with MSS SP-72.
 2. CWP Rating: Minimum 200 psi.
 3. Body: Cast iron or ductile iron.
 - a. Cast Iron: ASTM A126 gray iron; internally epoxy-lined; Class 125 flanges.
 - b. Ductile Iron: ASTM A395/A395M or ASTM A536 ductile iron; internally epoxy-lined; Class 150 flanges.
 4. Seats: PTFE.
 5. Stem: Stainless steel.
 6. Ball: Stainless steel.
 7. Operator: Lockable lever handle or gear operator.

2.07 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Wafer and Lug Style:
 1. Class 125, or Class 150 flanges.
 2. Comply with MSS SP-67, Type I.
 3. Wafer Style, Service Pressure Ratings:
 - a. 2 to 12 inch: 200 psi.
 - b. 14 to 24 inch: 150 psi.
 4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
 5. Stem: One or two-piece stainless steel.
 6. Seat: EPDM.
 7. Disc: Aluminum-bronze.
 8. Finish: Epoxy coated.
 9. Operator: Lockable handle over direct-mount actuator base.

2.08 IRON, GROOVED-END BUTTERFLY VALVES

- A. CWP Rating: 175 psi.
 1. Comply with MSS SP-67, Type I.
 2. Body: Coated ductile iron.
 3. Stem: Two-piece stainless steel.
 4. Disc: Coated ductile iron.
 5. Disc Seal: EPDM.

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2.09 BRONZE, SWING CHECK VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
 - 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 - 2. Design: Y-pattern, horizontal or vertical flow.
 - 3. WOG Rating: 200 psi.
 - 4. Body: Bronze.
 - 5. End Connections: Threaded.
 - 6. Disc: Bronze.

2.10 IRON, HORIZONTAL SWING CHECK VALVES

2.11 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125 with Lever and Spring-Closure Control.
 - 1. Comply with MSS SP-71, Type I.
 - 2. Description:
 - a. CWP Rating: 200 psi.
 - b. Design: Clear or full waterway.
 - c. Body: ASTM A126, gray iron with bolted bonnet.
 - d. Ends: Flanged as indicated.
 - e. Trim: Bronze.
 - f. Gasket: Asbestos free.
 - g. Closer Control: Factory installed, exterior lever, and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

- A. Class 300:
 - 1. CWP Rating: 300 psi.
 - 2. Body: ASTM A536, Grade 65-45-12 ductile iron.
 - 3. Seal: EPDM.
 - 4. Disc: Ductile iron.
 - 5. Coating: Black, non-lead paint.

2.13 IRON, CENTER-GUIDED CHECK VALVES

2.14 BRONZE, GATE VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
 - 3. Used for BELOW GRADE INSTALLATIONS
- B. Rising Stem or OS&Y (OVER 2"):
 - 1. Pressure-Temperature Range: MSS SP-80, Type I.
 - 2. Body: Bronze with integral seat and screw-in bonnet.
 - 3. End Connections: Threaded or solder.
 - 4. Stem: Bronze.
 - 5. Disc: Solid wedge; bronze.
 - 6. Packing: Asbestos free.
 - 7. Handwheel Operator: Malleable iron.

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- C. Non-Rising Stem or NRS (2" AND BELOW):
 - 1. Pressure-Temperature Range: MSS SP-80, Type I.
 - 2. Class 125:
 - 3. Class 150: CWP Rating; 300 psi.
 - 4. Body: Bronze with integral seat and screw-in bonnet.
 - 5. Ends Connections: Threaded or solder.
 - 6. Stem: Bronze.
 - 7. Disc: Solid wedge; bronze.
 - 8. Packing: Asbestos free.
 - 9. Handwheel Operator: Malleable iron.

2.15 BRONZE, GLOBE VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125 and Class 250:
 - 1. Class 125:
 - a. WOG Rating: 200 psi.
 - b. WSP Rating: 125 psi, saturated.
 - 2. Class 250: WOG Rating; 300 psi.
 - 3. Comply with MSS SP-80, Type 1.
 - 4. Body: Bronze with integral seat and screw-in bonnet.
 - 5. End Connections: Threaded or solder.
 - 6. Bonnet: NRS; Non-rising Stem.
 - 7. Non-Rising Stem: Bronze.
 - 8. Disc: PTFE.
 - 9. Packing: Asbestos free.
 - 10. Handwheel Operator: Malleable iron.

2.16 IRON, GLOBE VALVES

- A. Class 125 and Class 250:
 - 1. Class 125, WOG Rating: 200 psi.
 - 2. Class 250, WOG Rating: 500 psi.
 - 3. Comply with MSS SP-85, Type I.
 - 4. Body: Gray iron; ASTM A126, with bolted bonnet.
 - 5. Connection Ends: Flanged.
 - 6. Trim: Bronze.
 - 7. Packing and Gasket: Asbestos free, adjustable.
 - 8. Operator: Handwheel or chainwheel.
 - 9. Pressure and Temperature Rating: ASME B16.1.

2.17 STAINLESS STEEL, GLOBE VALVES

- A. Class 150:
 - 1. Body and Disc: ASTM A351/A351M-CF8M.
 - 2. Bonnet: NRS; Non-rising Stem.
 - 3. WOG Rating: 150 psi.
 - 4. End Connections: Flanged.
 - 5. Trim: Stainless steel.
 - 6. Packing and Gasket: Asbestos free.
 - 7. Operator: Malleable iron handwheel.

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8. Pressure and Temperature Rating: ASME B16.34.

2.18 LUBRICATED PLUG VALVES

- A. Regular Gland with Flanged Ends:
 - 1. Comply with MSS SP-78, Type II.
 - 2. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
 - 3. Pattern: Regular or short.
 - 4. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe or ball valves for throttling, bypass, or manual flow control services.
- F. Provide plug valves in gas systems for shut-off service.
- G. Coordinate installation of solenoid valves with Electrical Contractor.
- H. Provide the Owner with a valve chart indicating location, valve number, size, manufacturer, purpose, etc. Frame valve chart under glass.

END OF SECTION 22 05 23

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Strut systems for pipe or equipment support.
- B. Beam clamps.
- C. Pipe hangers.
- D. Pipe rollers and roller supports.
- E. Pipe supports, guides, shields, and saddles.
- F. Nonpenetrating rooftop supports for low-slope roofs.
- G. Anchors and fasteners.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

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- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- N. UL (DIR) - Online Certifications Directory; Current Edition.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

1.05 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

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PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Vibration Isolation and Seismic Restraint Requirements: See Section 22 05 48.
- F. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
 - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.02 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

- A. Strut Channels:
 - 1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
 - 2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- B. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
- C. Channel Nuts:
 - 1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.03 BEAM CLAMPS

- A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- B. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- C. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

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- D. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.04 PIPE HANGERS

- A. Band Hangers, Adjustable:
 - 1. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. Clevis Hangers, Adjustable:
 - 1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 - 2. Standard-Duty: MSS SP-58 type 1, zinc-plated.

2.05 PIPE CLAMPS

- A. Riser Clamps:
 - 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 - 2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 3. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- B. Strut Clamps:
 - 1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
- C. Insulation Coupling:
 - 1. Two bolt-type clamps designed for installation under insulation.
 - 2. Material: Carbon steel with epoxy copper or zinc finish.

2.06 PIPE ROLLERS AND ROLLER SUPPORTS

- A. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
- B. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.07 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Stanchions:
 - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- C. U-Bolts:
 - 1. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Intermediate Anchors and Pipe Alignment Guides:
 - 1. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.
 - 2. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
 - 3. Pipe Size 10 inch: 0.75 inch U-bolt.

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4. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
5. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.
6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- E. Pipe Alignment Guides:
 1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
 2. Pipe Sizes 10 inch and Larger: Roller type.
- F. Pipe Shields for Insulated Piping:
 1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Service Temperature: Minus 40 to 178 degrees F.
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- G. Pipe Supports:
 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
- H. Pipe Supports, Thermal Insulated:
 1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Provide pipe supports for 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Minimum Thickness: 60 mil, 0.06 inch.

2.08 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

- A. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- B. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- C. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

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2.09 ANCHORS AND FASTENERS

- A. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- B. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- C. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- D. Hollow Masonry: Use toggle bolts.
- E. Hollow Stud Walls: Use toggle bolts.
- F. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- G. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - 1. Channel Material: Use galvanized steel.
 - 2. Manufacturer: Same as manufacturer of metal strut channel framing system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

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2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
 - J. Secure fasteners according to manufacturer's recommended torque settings.
 - K. Remove temporary supports.
 - L. The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.
 - M. In no case shall this Contractor be allowed to cut or reduce the specified covering to allow the application of a smaller hanger than required.
 - N. Hangers supporting vertical and horizontal copper piping, sized 1 ½" in diameter and larger, shall be spaced on not more than 10-foot centers and 30" of each change or direction.
 - O. Hangers supporting vertical and horizontal copper piping, sized 1 ¼" in diameter and smaller, shall be spaced on not more than 6-foot centers and 30" of each change of direction.
 - P. Hangers supporting vertical and horizontal PVC piping of any size shall be spaced on not more than 4-foot centers and 30" of each change of direction.
 - Q. Hangers supporting vertical and horizontal CPVC piping 1 ¼" in diameter and larger shall be spaced on not more than 4-foot centers and 30" of each change of direction.
 - R. Hangers supporting vertical and horizontal CPVC piping 1" in diameter and smaller shall be spaced on not more than 3-foot centers and 30" of each direction.
 - S. Hangers supporting horizontal cast iron piping of any size shall be spaced not more than 5-foot centers and 30" of each change of direction, with a minimum of two hangers per section.
 - T. Hangers supporting vertical cast iron piping of any size shall be spaced on not more than 10-foot centers and 30" of each change of direction, with a minimum of two hangers per section.
 - U. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for all pipe sizes 4" and larger.
 - V. Vertical risers shall be supported at each floor, 5-feet on center, and/or at changes in direction of pipe.

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- W. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, black steel, 1/2" in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceilings shall be flush. Sleeves through floors shall extend two inches above finished floor. Sleeves in exterior walls shall be caulked and made water-tight.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 22 05 29

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SECTION 22 05 33 - HEAT TRACING FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Self-regulating parallel resistance electric heating cable.
- B. Controls.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment

1.02 REFERENCE STANDARDS

- A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2022.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.
- B. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for electric heat tracing.
- C. Shop Drawings: Indicate electric heat tracing layout, electrical terminations, thermostats, controls, and branch circuit connections.
- D. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.
- E. Field Quality Control Submittals: Indicate test reports and inspection reports.
- F. Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

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- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty for cables, connection kits, accessories, and controls.

PART 2 PRODUCTS

2.01 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

- A. Provide products listed, classified, and labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction (AHJ).
- B. Factory Rating and Testing: Comply with IEEE 515.1.
- C. Heating Element:
 - 1. Provide pair of parallel No.16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
 - 2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
 - 3. Capable of crossing over itself without overheating.
- D. Self-regulating cable shall vary its power relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.
- E. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:
 - 1. Retention of at least 75 percent of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.
 - 2. Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 216-1 Part 1.
- F. All cables shall be capable of passing a 2.5 kV dielectric test for one minute (ASTM 2633) after undergoing a 0.5 kg-m impact.
- G. Minimum Self-Regulating Indices:

Heating Cable	S.R. Index (W/deg F)
1. 3 W/ft	0.038
2. 5 W/ft	0.060
3. 8 W/ft	0.074
4. 10 W/ft	0.100
- H. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit as measured by the temperatures of 50 degree F and 100 degree F and confirmed by the type of test and published data sheets.

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- I. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal run-away and self-ignition, the cable shall produce less than 0.5 watts per foot when energized and heated to 350 degrees F for 30 minutes. After this test, if the cable is reenergized, it must not have an increasing power output leading to thermal runaway.
- J. The self-regulating cable shall retain at least 90 percent of its original power output after having been cycled 300 times between 50 degrees F and 210 degrees F, allowing at least six minutes of dwell time at each temperature.
- K. Insulated Jacket: Flame retardant polyolefin.
- L. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.
- M. Maximum Power-On Operating Temperature: 150 degrees F.
- N. Maximum Power-Off Exposure Temperature: 185 degrees F.
- O. Electrical Characteristics:
 - 1. Refer to the Drawings.

2.02 CABLE OUTER JACKET MARKINGS

- A. Name of manufacturer, trademark, or other recognized symbol of identification.
- B. Catalog number, reference number, or model.
- C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
- D. Agency listing or approval.
- E. Applicable environmental or area use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) location markings including temperature rating.
- F. Any applicable warning/caution statements such as "WARNING: De-energize circuit before removing cover.

2.03 CONNECTION KITS

- A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
- B. Provide with NEMA 4X rating for prevention of corrosion and water ingress.
- C. Provide UV stabilized components.

2.04 ACCESSORIES

- A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
 - 1. High temperature, glass filament tape for attachment of heating cable to metal piping.
 - 2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
 - 3. Heat-conductive putty.
 - 4. Cable ties.
 - 5. Silicone end seals and splice kits.
 - 6. Installation clips.
 - 7. Warning labels for attachment to exterior of piping insulation. Refer to Section 22 05 53.

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8. Provide integral GFCI protection for all heat trace.

2.05 CONTROLS

- A. Pipe Mounted Thermostats:
 1. Provide Pilot Light indicator.
 2. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.
 3. Control Enclosure: Corrosion resistant and waterproof for each chiller.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping and equipment are ready to receive work.
- B. Verify field measurements are as indicated on shop drawings.
- C. Verify required power is available, in proper location, and ready for use.

3.02 PREPARATION

- A. Clean exposed surfaces prior to installation.
- B. Prepare surfaces using approved methods as recommended by manufacturer.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written installation instructions.
- B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.
- C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.
- D. Comply with applicable local building codes and requirements of authorities having jurisdiction.
- E. Identification:
 1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform start-up by factory representative as per Owner's requirements.
- C. Field Testing and Inspections:
 1. Commission system in accordance with installation and operation manual.
 2. Inspect for sources of water entry and proper sealing.
 3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
 4. Insulation Resistance: Greater than 20 megohms at a test voltage of 2500 VDC for polymer insulated trace heaters.
 5. Test heating cable integrity with megohmmeter at the following intervals:

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6. Measure voltage and current at each unit.
7. Controls:
8. Submit written test report showing values measured on each test for each cable.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstrate operation of controls.

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 22 05 33

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SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.
- D. Vibration-isolated and/or seismically engineered roof curbs.

1.02 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

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2. Seismic Controls: Include seismic load capacities.
 - D. Shop Drawings - Vibration Isolation Systems:
 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- 1.06 QUALITY ASSURANCE
- A. Comply with applicable building code.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 1. Select vibration isolators to provide required static deflection.
 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 3. Select vibration isolators for outdoor equipment to comply with wind design requirements.
- D. Equipment Isolation:
 1. Equipment Type: Isolate all motor driven mechanical equipment, unless otherwise noted, from building structure, and from systems which they serve, to prevent equipment vibrations from being transmitted to structure. Unless specifically indicated, follow the latest edition of ASHRAE Application Handbook - Sound and Vibration Control, or manufacturer's recommendations for isolator selection, whichever is more stringent.
 - a. Select and locate isolators to produce uniform loading and deflection. Use a minimum of 4 isolators to support each piece of equipment.
 - b. Select vibration isolation devices based on the lowest operating speed of equipment.
- E. Piping Isolation:
 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 2. Minimum Static Deflection:

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- a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
- b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.

2.02 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 - d. Vibro-Acoustics: www.vibro-acoustics.com/#sle.
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.

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- c. Furnished with integral leveling device for positioning and securing supported equipment.
- 4. **Housed Spring Isolators:**
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
 - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
 - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - d. Furnished with integral leveling device for positioning and securing supported equipment.
- 5. **Restrained Spring Isolators, Nonseismic:**
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
- 6. **Resilient Material Isolator Hangers, Nonseismic:**
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
- 7. **Spring Isolator Hangers, Nonseismic:**
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 8. **Combination Resilient Material/Spring Isolator Hangers, Nonseismic:**
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

2.03 ACOUSTICAL AND VIBRATION ISOLATORS

- A. **General Requirements:**
 - 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.04 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

- A. **Manufacturers:**
 - 1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.

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- b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 - d. BRD.
- B. Vibration Isolation Curbs:
 - 1. Nonseismic Curb Rail:
 - a. Location: Between existing roof curb and rooftop equipment.
 - b. Construction: Aluminum.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Weather exposed components consist of corrosion resistant materials.
 - 2. Nonseismic Curb:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Aluminum.
 - c. Integral vibration isolation to comply with requirements of this section.
 - d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 2. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.

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3. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
4. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
5. Adjust isolators to be free of isolation short circuits during normal operation.
6. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 1. Verify isolator static deflections.
 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 22 05 48

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Underground warning tape.
- E. Ceiling tacks.
- F. Section 09 91 23 - Interior Painting: Identification painting.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch diameter and smaller.
 - 2. Manual operated and automated control valves.
 - 3. Instrumentation, relays, gauges, and other related control equipment products.
 - 4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.

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- C. Pipe Markers: 3/4 inch diameter and higher.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Brady Corporation.
 - 5. Preferred Utilities Mfg. Corp.
- B. Description: Laminated three-layer plastic piece with up to three lines of text.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.
 - 4. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
 - 2. Brady Corporation: www.bradycorp.com/#sle.
 - 3. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 6. Seton Identification Products: www.seton.com/#sle.
- B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- C. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products: www.seton.com/#sle.
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service. Message must repeat within a maximum of 40". Printed legend shall be indicative of type of underground line. Underground gas lines shall have insulated copper tracer wire, minimum 18 AWG with insulation suitable for direct burial and ends shall terminate above grade.

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- E. Identification Scheme, ASME A13.1:
 - 1. Primary: External Pipe Diameter, Uninsulated or Insulated.

2.05 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, 0.005 inch, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.

2.06 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 2. MSI.
 - 3. Seton.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Install label on ceiling grid in proximity to device above ceiling. Indicate type of device and associated service on label. (e.g. "CW-21"). Next to label, on ceiling grid, provide round dot.
- D. Provide custom printed labels, either of vinyl suitable for indoor/outdoor applications or of polypropylene for each device. Utilize portable printer equal to Brady HandiMark Portable Industrial Labeling System.
- E. Maximum height of label is one inch. Black lettering on white tape. Font size 18.
- F. Color code as follows unless Owner has their own standard - Contractor to verify prior to start of work:

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Ceiling grid markers shall be the color as indicated below. Beside all colored grid markers, a printed label shall be used to specify what the color marker is locating. Labels shall be no more than 1-inch in height. Lettering shall be minimum 18-point font. Lettering shall be black on white tape.

<u>Sample</u>	<u>Color</u>	<u>Item Marker is Identifying</u>
	Neon Red	Electrical – Pull Box/Future/Disconnects, etc.
	Neon Yellow	Mechanical-Equipment/Fan/Dampers, etc.
	Neon Green	Camera Drops
	Neon Orange	Wireless Access Point
	Blue	Domestic Cold Water-Valves/Arrestor, etc. Chilled Water-Valves, tc.
	Yellow	Gas – Valves/Regulators, etc.
	Green	Domestic Hot Water-Valves, etc. Heating Hot Water-Valves, etc.
	Red	Fire Alarm/Sprinklers/Life Safety

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

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- F. Apply ASME A13.1 Pipe Marking Rules:
 - 1. Place pipe marker adjacent to changes in direction.
 - 2. Place pipe marker adjacent each valve port and flange end.
 - 3. Place pipe marker at both sides of floor and wall penetrations.
 - 4. Place pipe marker every 25 to 50 feet interval of straight run.
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.
- H. All exposed piping in mechanical rooms, boiler rooms, on and above mezzanine levels, both insulated and uninsulated, shall be either painted or color coded using 0.030" PVC jacketing by the Plumbing Contractor and labeled by the Contractor as per the following schedule:
 - 1. Domestic Cold Water: Blue
 - 2. Domestic Hot Water: Red
 - 3. Makeup Water: Green
 - 4. Fuel Gas: Yellow
 - 5. Non-Potable Water: Purple
- I. All non-potable water outlets shall include a phenolic sign with yellow background and black letters 1/2" high stating: "NON-POTABLE WATER – NOT SAFE FOR DRINKING"
- J. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.
- L. Identify water heaters, with plastic nameplates. Small devices may be identified with tags.
- M. Identify control panels, manual motor starters, combination motor starters, disconnects, emergency shutoff switches, water heater override switches, water heater emergency switches and major control components outside panels with plastic nameplates.
- N. Identify aquastats or temperature sensors relating to water heaters or valves with nameplates.
- O. Identify valves in main and branch piping with valve tags.
- P. Tag automatic controls, instruments, and relays. Key to control schematic.
- Q. Identify water heaters with plastic nameplates indicating unit number and area served.
- R. Identify pumps with plastic nameplates indicating pump number and system served.

3.03 SCHEDULE

- A. Standard Color Identification for Plumbing Piping unless Owner has their own standard - Contractor to verify prior to start of work (all labels shall be provided with flow arrows):

Identification for Plumbing Piping and
Equipment
The Wooten Company

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1. Domestic Cold Water: White Lettering/Green Background
 2. Domestic Hot Water: Black Lettering/Yellow Background
 3. Domestic Hot Water Return: Black Lettering/Yellow Background
 4. Fuel Gas Piping: Black Lettering/Yellow Background
 5. Fuel Oil Piping: Black Lettering/Yellow Background
 6. Compressed Air: White Lettering/Blue Background
 7. Roof Drain: Black Lettering/White Background
 8. Overflow Roof Drain: Black Lettering/White Background
 9. Condensate Drain: Black Lettering/White Background
 10. Non-Potable Water: Black Lettering/Yellow Background
- B. All medical gas piping shall conform to NFPA 99 marking standards.

END OF SECTION 22 05 53

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SECTION 22 05 70 - PLUMBING COORDINATION DRAWINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The Plumbing Contractor shall be responsible for providing 1/4 scale coordination drawings for the entire project, format shall be as stated below.
- B. The drawings shall cover the above ceiling space, mechanical rooms, electrical rooms and service yards.

PART 2 EXECUTION

2.01 COORDINATION (REVIT)

- A. The Plumbing Contractor shall obtain the architectural, structural, and MEP REVIT models from the Architect. The models will be in REVIT 2021 or later.
- B. The Plumbing Contractor shall produce drawings that indicate all piping, including underground piping, and equipment on 1/4 scale drawings. All items shall be drawn to scale, dimensioned, and be easily identified. The drawings shall indicate the bottom of pipe.
- C. The Plumbing Contractor shall provide the Mechanical Contractor with a file compatible with Navisworks that indicates all piping and plumbing equipment.
- D. The overall coordination drawings shall be completed prior to any plumbing, mechanical and electrical work beginning. Start of work, including underground work, without completed Coordination Drawings is at the Contractor's risk.

END OF SECTION 22 05 70

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SECTION 22 07 16 - PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible elastomeric cellular insulation.
- B. Flexible glass fiber insulation.
- C. Rigid glass fiber insulation.
- D. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2026.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- E. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.
- G. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks; 2025.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

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1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 FLEXIBLE GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K Value: 0.36 at 75 degrees F.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Insulation: ASTM C1393; pipe and tank, end grain adhered to jacket.
 - 1. K Value: 0.27 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 2. Secure with self-sealing longitudinal laps and butt strips.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 RIGID GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.

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2. Johns Manville Corporation: www.jm.com/#sle.
3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 1. K Value: 0.25 at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F.
 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 4. Maximum Density: 8.0 pcf.
- C. Vapor Barrier Jacket:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with self-sealing longitudinal laps and butt strips.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
 2. Armacell LLC: www.armacell.us/#sle.
 3. K-Flex USA LLC: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.

2.05 JACKETING AND ACCESSORIES

- A. PVC Plastic:
 1. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
- C. Aluminum Jacket:
 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch sheet.
 3. Finish: Embossed.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

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PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.
- H. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- I. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert location: Between support shield and equipment and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- J. Finish insulation at supports, protrusions, and interruptions.
- K. Exterior Applications:
 - 1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
 - 2. Cover with aluminum.
- L. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

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END OF SECTION 22 07 16

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SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cellular glass insulation.
- B. Glass fiber insulation.
- C. Jacketing and accessories.
- D. Section 07 84 00 - Firestopping.

1.02 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2025.
- C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

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PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid, preformed pipe insulation, noncombustible.
 - 1. K Value: 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 CELLULAR GLASS INSULATION

- A. Insulation: ASTM C552, Type II, Grade 6.
 - 1. K Value: 0.35 at 100 degrees F.
 - 2. Service Temperature Range: From 250 degrees F to 800 degrees F.
 - 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.

2.04 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
- C. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch sheet.

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3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All valve handles on insulated piping shall be extended beyond the surface of the insulation using approved listed valve stem handle extensions made by same manufacturer of the valves.
- C. Exposed Piping in Mechanical Spaces and Exposed to Public View Piping (open ceiling): Shall be covered with eight-ounce canvas jacket, pasted in place and glue sized twice for painting - locate insulation and cover seams in least visible locations. Canvas shall be coated twice with Foster fireproof lagging to assure flame and smoke spread ratings. Coordinate sequencing with painting schedule and finishes - refer to architecture documents for painting requirements at Open-to-View ceilings.
- D. All waste piping above slab carrying cold condensate, for instance roof drain piping carrying cold condensate from rooftop mechanical units, including traps and floor drain bodies, except in a crawl space, shall be fully insulated as specified herein within the thermal envelope.
- E. All horizontal storm drain piping above slab on grade and all vertical risers up to, and including, elbows and roof drain bodies, shall be fully insulated as specified herein.
- F. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- G. Exposed Piping: Locate insulation and cover seams in least visible locations.
- H. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- I. Glass fiber insulated pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- J. Glass fiber insulated pipes conveying fluids above ambient temperature:

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1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- K. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert Location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.
- M. Pipes in CMU Walls: Pipe sizes 1/2 and 3/4 inch diameter piping inside block walls wrap from points entering to points existing block walls. No piping shall be in contact with concrete or CMU.
- N. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with cellular glass insulation with PVC jacket and fitting covers..
- O. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- P. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- Q. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

- A. Plumbing Systems:
1. Domestic Hot Water Supply:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: 0-6 inch.
 - 2) Thickness: 1 inch.
 - b. Cellular Foam Insulation:
 - 1) Pipe Size Range: 0-6 inch.
 - 2) Thickness: 1 inch.
 2. Domestic Hot Water Recirculation:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.

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- 2) Thickness: 1 inch.
- 3. Tempered Domestic Water Supply:
 - a. Same as Domestic Hot Water Supply.
- 4. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
- 5. Roof Drain Bodies:
 - a. Glass Fiber Insulation:
 - 1) Thickness: 1 inch.
- 6. Roof Drainage Above Grade:
 - a. Glass Fiber Insulation:
 - 1) Thickness: 1 inch.
- 7. Mechanical Condensate, including traps and floor drain bodies.
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.

END OF SECTION 22 07 19

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SECTION 22 08 00 - PLUMBING COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

A. Commissioning

1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
 - a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - b. Verify and document proper functional performance of equipment and systems.
 - c. Verify that O&M documentation is complete.
 - d. Verify that the Owner's operating personnel are adequately trained.

1.02 RELATED WORK

- A. Section 011000 – Summary of Work
- B. Section 013300 – Submittal Procedures
- C. Section 017700 – Closeout Procedures
- D. Section 017823 – Operation and Maintenance Data
- E. Section 017839 – Project Record Document
- F. Section 017900 – Demonstration and Training
- G. Section 019113 – General Commissioning Requirements
- H. Division 22 - Plumbing

1.03 ABBREVIATIONS AND DEFINITIONS

- A. A/E: Architect, Architect/Engineer, and/or Engineer
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR
- E. CxA: Commissioning Authority
- F. Controls Contractor
- G. CM: Construction Manager
- H. Cx: Commissioning
- I. Cx Plan: Commissioning Plan

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- J. Cx RFI: Commissioning Request for Information
- K. DDC: Direct Digital Control System
- L. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- M. EC: Electrical Contractor
- N. FBO: Furnished By Others
- O. FT: Functional Performance Test
- P. IAW: In Accordance With
- Q. MC: Mechanical Contractor
- R. O&M: Operation and Maintenance
- S. OPM: Owner Project Manager
- T. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- U. PC: Prefunctional Checklist
- V. RFI: Request for Information
- W. Sub(s): Subcontractors or Prime Contractor
- X. TC: Testing Contractor
- Y. TBD: To Be Determined

1.04 PLUMBING SYSTEMS TO BE COMMISSIONED

- A. Domestic hot water systems
- B. Natural gas supply equipment
- C. Compressed air equipment
- D. Sump pumps and sump pump controls

1.05 SUBMITTALS

- A. Refer also to Specification Section 019113, Subsection 1.6.
- B. Provide the CxA a copy of the following items, for the systems to be commissioned:
 - 1. Equipment and System Submittals to include, at minimum, the following:
 - a. Cut Sheets
 - b. Performance data
 - c. Manufacturer's pre-startup checklists
 - 1) Manufacturer's start-up checklists
 - 2) Installation Instructions
 - d. Shop drawings (including any resubmittals required by the A/E)
 - e. Test plan
 - f. Completed field test report, including all completed forms and checklist; and list of all outstanding deficiencies and uncompleted items
 - g. Operational and maintenance documentation

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- h. Training plan and training materials
- i. As-built documentation

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Specification Section 019113, Subsection 2.1.
- B. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Camera equipment capable of viewing an entire pipe assembly at one time.

2.02 CX WEB-BASED COMMISSIONING TOOL

- A. Refer to Specification Section 019113, Subsection 2.1.

PART 3 EXECUTION

3.01 MEETINGS

- A. Refer to Specification Section 019113, Subsection 3.3.

3.02 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.4 above.
- B. General Contractor shall complete plumbing testing as required in sections 220500 and 225000.
- C. Testing Plan
 - 1. The subcontractor responsible for providing and installing the equipment completes the testing plan. The test plan will include checklists and procedures with specific boxes or lines for recording and documenting the tests, and a summary statement with a signature block at the end of the plan.
 - 2. The contractor submits the full test plan to the A/E and CxA for review and approval.
- D. Execution of Testing Plan
 - 1. Two weeks prior to testing, the Subs and vendors schedule testing with the OPM, CM and CxA. The performance of the tests are directed and executed by the Sub or vendor.
 - a. The CxA and possibly the A/E will observe the testing procedures for selected pieces of equipment.
 - 2. The Subs and vendors shall execute testing and provide the CM with a signed and dated copy of the completed testing report. The CM reviews for completion and accuracy, then submits to the CxA and A/E.
 - 3. Only individuals that have direct knowledge and witnessed that a line item task on the testing was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
- E. Deficiencies, Non-Conformance and Approval in Checklists and Startup

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1. The Sub(s) shall clearly list any outstanding items of the initial testing that were not completed successfully. The testing forms and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional performance testing may result in backcharges to the responsible party. Refer to Section 019113, 3.7 – Documentation, Non-Conformance and Approval of Tests.

3.03 FUNCTIONAL PERFORMANCE TESTING, VERIFICATION AND VALIDATION

A. Objectives and Scope

1. The contractor will perform functional performance testing of the water heating equipment and any plumbing automation system integration with the EMS.
2. The objective is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
3. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, OPM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection.
4. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
5. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before demonstration testing commences.

B. Coordination and Scheduling

1. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the testing of all equipment and systems. The CxA will schedule demonstration and validation after written notification from the CM and affected Subs. The CxA shall direct, witness and document the demonstration retesting of equipment and systems. The Subs shall execute the tests.
2. In general, functional performance testing shall not be scheduled until all equipment submittals are approved, testing plans are approved, testing has been satisfactorily completed, and testing report has been provided. Scheduling of testing shall be done with a minimum of two weeks notice prior to testing. Testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.

C. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.

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3.04 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Refer to Specification Section 019113, Subsection 3.7.

3.05 OPERATION AND MAINTENANCE MANUALS

- A. In addition to installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing. O&M Manuals shall be in electronic form, the file format shall be Adobe Acrobat readable document. The document shall be formatted to include level 1 bookmarks that link to each main section of equipment. Refer to specification section 01 9113, subsection 3.8 for further detail.

3.06 TRAINING OF OWNER PERSONNEL

- A. See Specification Section 019113, Subsection 3.9.
- B. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of cabling systems.
- C. Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment.

3.07 DEFERRED TESTING

- A. See Specification Section 019113, Subsection 3.10.

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SECTION 22 10 05 - PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet of building.
- D. Domestic water piping, above grade.
- E. Pipe flanges, unions, and couplings.
- F. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
- G. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

1.02 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- C. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; 2021.
- D. ASME B31.9 - Building Services Piping; 2025.
- E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.
- F. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2025.
- G. ASTM B32 - Standard Specification for Solder Metal; 2020.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- J. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- K. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- L. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- M. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- N. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- O. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.

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- P. AWWA C651 - Disinfecting Water Mains; 2023.
- Q. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- R. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- S. FM 1680 - Examination Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 2025.
- T. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- U. IAPMO/ANSI/CAN Z1117 - Standard for Press Connections; 2022.
- V. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- W. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- X. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.
- D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- E. Project Record Documents: Record actual locations of valves.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

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- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, solder, and flux (if used), complying with NSF 61 and NSF 372; label pipe and fittings.

2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

2.03 SANITARY WASTE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies. Clamp-and-shield shall be made of 24 gauge type 304 stainless steel, clamp shall be capable of being tightened to 80 inch pounds of torque. Coupling shall be manufactured in accordance with CISPI 310-85.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L, drawn temper.
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: AWS A5.8, BCuP silver braze.
- B. Ductile Iron Pipe: AWWA C151/A21.51. (Larger than 2")
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch diameter rods.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn95 solder on water piping joints smaller than 1-1/2". Use silver solder on piping 1-1/2" and larger and on all joints underground.
 - 3. Joints: Grooved mechanical couplings on piping 3" and larger is acceptable.
 - 4. Mechanical Press Sealed Fittings: ASME B16.51 or IAPMO/ANSI/CAN Z1117, ICC (IPC), and IAPMO (UPC) approved, NSF 61 and NSF 372 certified, with EPDM seals.
 - a. Manufacturers:

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- 1) Apollo Valves: www.apollovalves.com/#sle.
- 2) Nibco.
- 3) Viega LLC

2.06 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch and Under:
 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Shielded, Heavy Duty No-Hub Couplings:
 1. Testing: In accordance with ASTM C1540 and FM 1680.
 2. Gasket Material: Neoprene complying with ASTM C564.
 3. Band Material: Stainless steel.
 4. Eyelet Material: Stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 22 05 16.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.
- J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

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- L. Provide support for utility meters in accordance with requirements of utility companies.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.
- P. Install water piping to ASME B31.9.
- Q. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- R. Sleeve pipes passing through partitions, walls, and floors.
- S. Testing of all piping under this contract shall be made in the presence of the Engineer or a designated representative of the Owner. No piping shall be covered or put into operation before such testing has been approved.
- T. Copper tubing which is out of round will not be acceptable.
- U. The arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainages, etc., shall be maintained.
- V. No notching or mitering of copper tubing will be permitted.
- W. Joints in Type "K" copper tubing will not be permitted underfloor unless otherwise noted on drawings.
- X. In pipe chases, the Contractor shall provide for suspension of all piping from the structure. Do not allow piping to rub against masonry when expanding and contracting.
- Y. Close and protect open ends of piping until final connections are made. Such closing shall be made with fittings which cannot be easily removed. Caps or plugs shall be required at all times during construction so that no pipes are left open at the end of any day's work, even though continuation is expected the next day.
- Z. Copper pipe ends shall be reamed, sanded and deburred before soldering. Non-corrosive flux shall be used.
- AA. Any leaky joints shall be remade with new materials. Caulking to make joints tight is absolutely prohibited.
- BB. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, Black Steel, ½ inch in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceiling shall be flush. Sleeves through floors shall extend 1 inch above finished floor. Sleeves installed in exterior walls shall be caulked and made water-tight.
- CC. Pipe joint compound shall be LACO, Hercules, Oatey, or Rector Seal.
- DD. All water piping shall be hydrostatically tested at 150 psig for a period of one hour.

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- EE. All piping and equipment installed under this Contract shall be tested in the presence of the Engineer and the proper Plumbing Inspector, and provided tight for the periods stated above, or longer if required by the Inspector. The test shall be administered in sections if deemed advisable.
- FF. No plumbing system or part thereof shall be covered or concealed until after it has been tested and approved. If such work has been covered or concealed before testing, it shall be exposed for testing.
- GG. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- HH. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
 - 8. Support cast iron drainage piping at every joint.
- II. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring-loaded check valves on discharge of water pumps.
- H. Provide flow controls in water recirculating systems where indicated.
- I. Coordinate installation of solenoid valves with Electrical Contractor.
- J. Provide plug valves in gas systems for shut-off service.

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3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
 - 1. Perform hydrostatic testing for leakage prior to system disinfection.
 - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 - 3. General:
 - a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
- C. Gas Distribution Systems:
 - 1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
 - 2. General Systems:
 - a. Inject a minimum of 10 psi of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
 - b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.
- D. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- D. Maintain disinfectant in system for 24 hours.
- E. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- F. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- G. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

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- H. During the flushing of the system, all flush valves shall be thoroughly flushed out to insure the removal of sediment, pipe dope, etc., from water lines and flush valves, removing such working parts of the flush valves as may be deemed necessary.
- I. After flushing of the system has been completed, the Contractor shall have water samples taken and delivered to an independent laboratory for testing to show that the water is suitable for drinking. Copies of the laboratory report shall be provided to the Owner and the Engineer. If the State Construction Office is involved, provide form "Water Test Report for Use."

3.08 DWV HYDROSTATIC TESTING

- A. Waste and vent piping shall be hydrostatically tested at each floor. A test tee will be installed below each floor and pipe will be filled with water for a height of 10' above finished floor. The pipe shall be gas and watertight. Water shall stand in the system for a period of 30 minutes without evidence of leakage. After the waste and vent piping has been hydrostatically tested for the entire system the piping shall be smoke tested using smoke bombs. The contractor shall plug waste line where it exits building, fill all of the traps with water and test the waste and vent piping by using a smoke bomb in a wall or floor cleanout. He shall install a plug on the cleanout once the smoke bomb has been dropped into the cleanout. The smoke bomb test shall be held for thirty minutes without evidence of leakage in the piping. The smoke bombs for this testing shall be furnished by the contractor. Once the testing of the piping has been completed, the contractor shall flush all of the smoke bombs from the waste piping system.
- B. All piping and equipment installed under this Contract shall be tested in the presence of the Engineer and the proper Plumbing Inspector, and proved tight for the periods stated above, or longer if required by the Inspector.
- C. The final test of the completed drainage and vent systems shall be visual and
- D. No plumbing system or part thereof shall be covered or concealed until after it has been tested and approved.
- E. If such work has been covered or concealed before testing, it shall be exposed for testing
- F. After the pipe is installed, tested and inspected, backfill shall be installed and compacted. Backfill material shall conform to ASTM D-2371 Soil Class III. Backfill shall be installed, compacted and tested in 6" layers up to 12" above top of pipe. Backfill shall continue in 12" layers to finished grade.

3.09 DWV UNDERGROUND CAMERA INVESTIGATION

- A. The entire underground waste piping system shall be videoed and recorded by the Contractor on an audible CD/DVD to ensure that the Owner knows the location of the piping being viewed. The recorded CD/DVD shall be provided to the Engineer of Record and the Owner's Project Manager three (3) weeks prior to Substantial Completion inspection. The Substantial Completion inspection cannot occur until the video has been reviewed and all the underground waste piping system has been approved by the Engineer in Record.

3.10 SCHEDULES

- A. Pipe Hanger Spacing:

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1. Metal Piping:
 - a. Pipe Size: 1/2 inch to 1-1/4 inch:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inch to 2 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inch to 3 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inch to 6 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.
 - e. Pipe Size: 8 inch to 12 inch:
 - 1) Maximum hanger spacing: 14 ft.
 - 2) Hanger Rod Diameter: 7/8 inch.

END OF SECTION 22 10 05

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SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vacuum breakers.
- B. Water pressure reducing valves.
- C. Mixing valves.
- D. Balancing valves.
- E. Strainers.
- F. Outlet boxes.
- G. Hose bibbs.
- H. Hydrants.
- I. Water-hammer arrestors.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- D. Store products under cover and protected from weather and dirt. Elevate above grade.
- E. Protect end connections, flanges, threads, and grooves from dirt and damage.
- F. Protect product interiors against rust and corrosion.
- G. Do not use operating handles or stems as lifting or rigging points.

1.04 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

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PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products complying with NSF 61 and NSF 372.
- B. Source Limitations: Furnish domestic water piping specialties of same kind by same manufacturer.
- C. Provide brass-bodied domestic water piping specialties in DZR brass.

2.02 VACUUM BREAKERS

- A. Atmospheric Vacuum Breakers:
 - 1. Manufacturers:
 - 2. Valve: ASSE 1001, brass, bronze, or copper silicon alloy.
 - 3. Maximum Working Pressure: 125 psi.
 - 4. Working Temperature Range: 33 to 180 degrees F.

2.03 WATER PRESSURE REDUCING VALVES

- A. Direct-Acting Pressure Reducing Valves:
 - 1. Manufacturers:
 - a. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 - b. Flomatic Valves: www.flomatic.com/#sle.
 - c. Wilkins by Zurn Water, LLC: www.zurn.com/#sle.
 - 2. Valve: ASSE 1003, bronze or copper silicon alloy body, with spring-loaded diaphragm; field-adjustable outlet pressure, and integral inlet screen strainer.
 - a. Diaphragm: EPDM or buna-nitrile.
 - b. Spring: Stainless steel.
 - 3. Maximum Working Pressure: 300 psi.
 - 4. Outlet Pressure Range: 15 to 75 psi.
 - 5. Working Temperature Range: 33 to 140 degrees F.

2.04 BALANCING VALVES

- A. Manual Balancing Valves:
 - 1. Valve: Brass, ball or globe valve design, with metering ports, position indicator, and memory stop.
 - 2. Maximum Working Pressure: 150 psi.
 - 3. Working Temperature Range: 33 to 200 degrees F.

2.05 STRAINERS

- A. Manufacturers:
- B. NPS 2 and Smaller:
 - 1. Body: Wye-pattern in brass, bronze, or copper silicon alloy.
 - 2. Screen: Stainless steel mesh.
 - 3. Pressure Rating: 200 psi.
- C. NPS 2-1/2 and Larger:
 - 1. Body: Wye-pattern ductile iron, epoxy-coated cast iron, or epoxy-coated ductile iron,
 - a. Epoxy Coatings: AWWA C550 or FDA approved.

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2. Screen: Perforated stainless steel.
3. Pressure Rating: 200 psi.

2.06 OUTLET BOXES

- A. Ice Maker Outlet Boxes:
 1. Manufacturers:
 - a. Oakley.
 2. Description: Plastic preformed square or round rough-in box with quarter-turn ball valve and slip-in finishing cover.

2.07 HYDRANTS

- A. Wall Hydrants:
 1. Manufacturers:
 - a. Effebi; Sky: www.effebi.com/#sle.
 - b. Metcraft Industries, Inc: www.metcraftindustries.com/#sle.
 - c. Zurn Water, LLC: www.zurn.com/#sle.
 2. Assembly: ASSE 1011, ASSE 1019, ASSE 1052, or ASSE 1053.
 3. Hydrant: Freeze-resistant, self-draining, wall-mounted.
 - a. Valve: Bronze or brass body.
 - b. Hose Connection: Threaded, with integral vacuum breaker or backflow preventer.
 4. Maximum Working Pressure: 125 psi.
 5. Working Temperature Range: 33 to 120 degrees F.

2.08 WATER-HAMMER ARRESTORS

- A. Manufacturers:
 1. Zurn Water, LLC: www.zurn.com/#sle.
- B. Piston Type:
 1. Description: ASSE 1010 or PDI-WH 201, copper body with plastic piston and EPDM O-rings.
 2. Air Preload Pressure: 60 psi.
 3. Maximum Working Pressure: 150 psi.
 4. Working Temperature Range: 33 to 180 degrees F.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard packing materials and verify product interiors are free from debris, damage, and corrosion.
- B. Verify end connections, flanges, threads, and grooves are completely clean without signs of damage or degradation that could result in leakage.
- C. For products containing isolation or shutoff valves, verify isolation and shutoff valves operate smoothly from fully closed to fully open.

3.02 INSTALLATION

- A. Prior to installation of domestic water piping specialties, flush domestic water piping of foreign material.

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- B. Install products in accordance with manufacturer's instructions.
- C. Install products level and plumb.
- D. Install products with clearance for access and maintenance.
- E. Support products NPS 2-1/2 and larger independently of surrounding pipe.
- F. Support products with flanged or grooved ends independently of surrounding pipe.
- G. For products containing isolation or shutoff valves, locate valves in horizontal piping with stems at or above center of piping, maintaining unimpeded stem movement.
- H. Balancing Valves: Install in accessible locations. Install shutoff valves on inlet and outlet.
- I. Water Hammer Arrestors: Install in accordance with PDI-WH 201.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect each product for damage and defects.
- C. Repair or replace damaged products.
- D. Replace defective products.
- E. For products containing isolation or shutoff valves, exercise isolation and shutoff valves from fully closed to fully open. Confirm smooth operation.
- F. Vacuum Breakers:
 - 1. Test in accordance with manufacturer's instructions.
 - 2. Test in accordance with requirements of authorities having jurisdiction.
 - 3. Test in accordance with ASSE listing of vacuum breaker.
 - 4. Replace vacuum breakers that fail testing.
- G. Water Pressure Reducing Valves: Confirm outlet pressure remains steady without fluctuation.
- H. Coordination of Other Tests and Inspections: Provide access to accommodate tests and inspections by independent testing agencies employed by Owner.

3.04 ADJUSTING

- A. Adjust pressure reducing valves to design pressure set point.
- B. Adjust balancing valves to design flow.

END OF SECTION 22 11 19

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SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Circulators.
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.

1.02 REFERENCE STANDARDS

- A. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.
 - 2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.
- C. Shop Drawings: Include dimensions and performance data.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Pump Seals: One of each type and size.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing type of products specified in this section, with minimum three years of documented experience.
- B. Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.
- C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

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- B. Manufacturer Warranty: Provide 1-year manufacturer warranty for pumps except circulator type. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 CIRCULATORS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a Brand of Xylem, Inc: www.xylem.com/#sle.
 - 3. Grundfos Pumps Corporation: www.grundfos.com/#sle.
 - 4. Taco, Inc: www.tacocomfort.com/#sle.
- B. Casing: Bronze with bronze cast impeller, and stainless steel rotor assembly.
- C. Shaft: Alloy steel with integral thrust collar and two oil-lubricated bronze sleeve bearings.
- D. Mechanical Seal: Carbon rotating against a stationary ceramic seat.
- E. Pipe-End Connection: Union connection.
- F. Maximum Discharge Pressure: 145 psi.
- G. Motor: 1,750 rpm, ECM duty with flexible coupling.
- H. Service Temperature Range: Minus 30 to 250 degrees F.
- I. Controls: Provide aquastat set for high-temp cutoff, electric plug, illuminated hand switch, and time clock set for business hours.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products with related fittings, and accessories according to manufacturer instructions.
- B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).
- C. Electrical-Driven Pump Work:
 - 1. Provide electric-motor-driven equipment specified complete with local disconnect switch and control panel with starter, controls, safety devices, and related wiring.
 - 2. Provide automatic control and protective devices field-wired to interface-related devices required for specified operation.
- D. Ensure that small pressure gauges are installed on both upstream and downstream ends.
- E. Factory-Provided Pump Controls: Factory provided, tested for use.
- F. ECM, VSD, or VFD Controlled Motors: Configure unit to operate within manufacturer-listed pump curve points unless factory set to do so. Then adjust to operate in automatic to maintain downstream pressure setpoint.

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- G. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- H. Coordinate BAS, BMS, or Integrated Automation linking between unit controller and remote front-end interface; see Section 23 09 23.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.03 CLEANING

- A. Thoroughly clean plumbing fixtures and equipment.
- B. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.04 PROTECTION

- A. Protect installed products from damage due from subsequent construction operations.
- B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION 22 11 23

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SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Floor drains.
- B. Cleanouts.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on fabrication materials, assembly of components, dimensions, ratings, finishes, rough-in requirements, and installed accessories.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- D. Store products under cover and protected from weather and dirt. Elevate above grade.
- E. Store plastic products protected from direct sunlight.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Plastic Sanitary Waste Piping Specialties: Provide plastic products that comply with NSF 14.
- B. Source Limitations: Furnish drains and sanitary waste piping specialties of same kind by same manufacturer.

2.02 FLOOR DRAINS

- A. Cast Iron Floor Drains:
 - 1. Manufacturers:
 - a. Zurn Water, LLC: www.zurn.com/#sle.
 - 2. Assembly: ASME A112.6.3.
 - 3. Body: Lacquered cast iron with anchor flange and membrane clamping collar with weepholes.
 - 4. Strainer: Adjustable, removable, with vandal-proof screws.
 - a. Round:
 - 1) Material: Nickel bronze.
 - 2) Diameter: 6 inches.

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2.03 CLEANOUTS

A. Manufacturers:

1. MIFAB, Inc: www.mifab.com/#sle.
2. Zurn Water, LLC: www.zurn.com/#sle.

B. Floor Cleanouts:

1. Assembly: ASME A112.36.2.
2. Body: Lacquered cast iron.
3. Closure Plug: PVC or ABS, threaded, gastight and watertight.
4. Top: Adjustable, with vandal-proof screws.
 - a. Shape and Finish:
 - 1) All Locations, Unless Noted Otherwise: Round; nickel bronze.
5. Accessories:
 - a. Clamp ring and flange for floors with waterproofing membrane.
6. Products:
 - a. MIFAB, Inc; C1100 Series: www.mifab.com/#sle.

C. Wall Cleanouts:

1. Assembly: ASME A112.36.2.
2. Body: Tee type; body material to match surrounding pipe.
3. Plug: PVC or ABS, threaded, gastight.
4. Access Cover: Round, stainless steel wall access cover with vandal-proof screw.
5. Products:

END OF SECTION 22 13 19

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SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tankless electric water heaters.
- B. Commercial electric water heaters.
- C. Diaphragm-type compression tanks.

1.02 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .
- D. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2024, with Amendment (2025).
- E. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data:
 - 1. Product Data: Provide manufacturer's literature and data sheets for each product. Include information on materials of fabrication, assembly of components, dimensions, weights, capabilities, performance, electrical characteristics, location and sizes of connections, service and access locations, and manufacturer-provided and field-installed accessories.
- C. Shop Drawings:
 - 1. Provide plans and elevations showing equipment assembly, including fabrication and installation details. Show location and sizes of connections.
 - 2. Indicate clearances required for service, access, maintenance, and replacement of internal components.
- D. Manufacturer's qualification statement.
- E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

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- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

- B. Certifications:

1. Water Heaters: NSF approved.
2. Indirect-Fired Gas Water Heaters: AHRI Directory of Certified Product Performance.
3. Electric Water Heaters: UL listed and labeled to UL 174.
4. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for domestic water heaters, water storage tanks, and packaged water heating systems. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Tankless Electric Water Heater:

1. Manufacturers:
 - a. Chronomite, Inc; _____: www.chronomite.com/#sle.
 - b. Navien.
 - c. Stiebel Eltron.
 - d. Lockinvar.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Water Inlet Pressure: From 30 psi to 150 psi.
4. Heater Type: Self-contained, wall-mounted unit capable of handling listed capacity, water-inlet strainer, removable thermally-insulated front panel, and threaded water pipe-end connections.
5. Heater-Heat Exchanger: Stainless steel, thermally insulated and encased assembly in corrosion-resistant steel jacket; baked-on enamel finish.
6. Safeties: Provide internal safeties for water flow, electrical load, and thermal load.
7. Controls: Color touchscreen interface for internal controls; temperature range adjustable from 120 to 170 degrees F using flanged or screw-in nichrome elements. Wire double-element units so elements do not operate simultaneously.
8. BAS, SCADA, or other Integrated Automation Link: IEEE 802.11 Wi-Fi wireless.
9. Accessories: Provide cold water inlet expansion tank, hot water recirculation pump, inlet ball valve, outlet ball valve, outlet ASME-rated temperature-pressure relief valve, and pipe-mounted thermometers.

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- B. Commercial Electric Water Heaters:
 - 1. Manufacturers:
 - a. Bradford White Corporation: www.bradfordwhite.com/#sle.
 - b. A.O. Smith.
 - c. Lochinvar.
 - d. State.
 - e. Rheem.
 - 2. Type: Factory-assembled and wired, electric, vertical storage.
 - 3. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 - 4. Performance:
 - a. See fixture schedule.
 - b. Minimum Recovery Rate: see fixture schedule gph with 100 degrees F temperature rise.
 - c. Maximum Working Pressure: 150 psi.
 - 5. Electrical Characteristics:
 - a. See fixture schedule for volts, single phase, 60 Hz.
 - b. See fixture schedule for amperes maximum fuse size.
 - 6. Tank: glass-lined, duplex alloy, nickel plating, or approved lining welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
 - 7. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
 - 8. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: By Manufacturer.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
 - 9. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.
 - 10. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com/#sle.
 - 2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 - 3. Taco, Inc: www.taco-hvac.com/#sle.
 - 4. Watts.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.
- B. Provide label on water heater to show warranty and substantial completion date.
- C. Flue Installation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Install in accordance with recommendations of ASHRAE - Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems", and ANSI Z223.1 (NFPA 54).
 - 3. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
 - 4. Support breechings from building structure rigidly, with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks every 12 feet, to adjacent structural surfaces. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.
 - 5. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
 - 6. Assemble and install stack sections in accordance with NFPA 211, industry practices, and in compliance with UL listing. Join sections with flange bands and high temperature silicone sealer supplied by the manufacturer.
 - 7. Level and plumb chimney and stacks.
 - 8. Clean breechings, chimney and stacks during installation, removing dust and debris.
 - 9. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, chimneys, or stacks.
- D. Domestic Hot Water Storage Tanks:
 - 1. Provide steel pipe support, independent of building structural framing members.
 - 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

END OF SECTION 22 30 00

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SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush valve water closets.
- B. Wall hung urinals.
- C. Lavatories.
- D. Sinks.
- E. Under-lavatory pipe supply covers.
- F. Electric water coolers.
- G. Bi-level, electric water coolers.
- H. Mop sinks.
- I. Service sinks.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- D. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.
- G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.
- H. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- I. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- L. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- M. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

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- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include materials of fabrication, rough-in requirements, location and sizes of connections, configurations, dimensions, finishes, features, and accessories.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide drinking water system components certified as complying with NSF 61 and NSF 372.
- B. ADA: Where indicated to be ADA-compliant, provide fixtures complying with ADA Standards and ICC A117.1.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 FLUSH VALVE WATER CLOSETS

- A. Water Closets:
 - 1. Vitreous china, ASME A112.19.2, see fixture schedule for mounting, siphon jet flush action, china bolt caps.
 - 2. Bowl: ASME A112.19.2; see fixture schedule for height with elongated rim.
 - 3. Flush Valve: see fixture schedule.
 - 4. Flush Operation: see fixture schedule.

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5. Handle Height: see fixture schedule for handle height in inches or less.
 6. Inlet Size: 1-1/2 inches.
 7. Trapway Outlet: 4 inch.
 8. Color: White.
 9. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Gerber Plumbing Fixtures LLC; _____: www.gerberonline.com/#sle.
 - c. Kohler Company: www.kohler.com/#sle.
 - d. PROFLO; Commercial - Wall-Mount, Rear Inlet Spud: www.ferguson.com/#sle.
 - e. Zurn Industries, LLC: www.zurn.com/#sle.
 - f. Sloan.
 - g. Toto.
- B. Flush Valves:
1. Manufacturers:
 - a. Advanced Modern Technologies Corporation; _____: www.amtcorporation.com/#sle.
 - b. Delany Products: www.delanyproducts.com/#sle.
 - c. Sloan Valve Company: www.sloanvalve.com/#sle.
 - d. Zurn Industries, LLC: www.zurn.com/#sle.
 - e. Hydrotek.
 2. Sensor-Operated:
 - a. Type: ASME A112.19.5; chloramine-resistant clog-resistant dual-seat diaphragm valve complete with vacuum breaker, stops and accessories.
 - b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with battery powered infrared sensor, and mechanical override or override push button.
 - c. Supplied Volume Capacity: 1.2 gal per flush.
 3. Concealed Type: Rough brass, exposed parts chrome-plated, wall escutcheon, wheel handle stop.
 4. Exposed Type: Chrome-plated, escutcheon, integral screwdriver stop.
 5. Metering Type: Easily accessible adjustment nut.
- C. Toilet Seats:
1. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Bemis Manufacturing Company: www.bemismfg.com/#sle.
 - c. Church Seat Company: www.churchseats.com/#sle.
 - d. Olsonite: www.olsonite.com/#sle.
 - e. Zurn Industries, LLC: www.zurn.com/#sle.
 2. Plastic: Solid, white finish, elongated shape, open front, hinged seat cover, extended back complete with self-sustaining hinges, and brass bolts with covers.
 3. Plastic: Black finish, open front, extended back, self-sustaining hinge, brass bolts, with cover.
- D. Water Closet Carriers:
1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company; _____: www.jrsmith.com/#sle.
 - b. JOSAM Company; _____: www.josam.com/#sle.
 - c. Zurn Water, LLC; Z1201-N: www.zurn.com/#sle.
 - d. Watts.

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2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.04 WALL HUNG URINALS

A. Manufacturers:

1. Advanced Modern Technologies Corporation; _____:
www.amtcorporation.com/#sle.
2. American Standard, Inc: www.americanstandard-us.com/#sle.
3. Gerber Plumbing Fixtures LLC; _____: www.gerberonline.com/#sle.
4. Kohler Company: www.kohler.com/#sle.
5. PROFLO; 1800 Series - Half Stall, Rear Outlet: www.ferguson.com/#sle.
6. Zurn Water, LLC: www.zurn.com/#sle.
7. Sloan.
8. Toto.

B. Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.

1. Consumption Volume: 0.125 gal per flush, maximum.
2. Flush Style: Siphon jet.
3. Flush Valve: Exposed (top spud).
4. Flush Operation: See Fixture Schedule.
5. Trapway Outlet: Integral.
6. Removable stainless steel strainer.

C. Flush Valves:

1. Manufacturers:

- a. American Standard, Inc: www.americanstandard-us.com/#sle.
- b. Delany Products: www.delanyproducts.com/#sle.
- c. Sloan Valve Company: www.sloanvalve.com/#sle.
- d. Zurn Industries, LLC: www.zurn.com/#sle.

2. Sensor-Operated:

- a. Type: ASME A112.19.5; chloramine-resistant, clog-resistant dual-seat diaphragm valve with vacuum breaker, stops and accessories.
- b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with battery powered infrared sensor, and mechanical override or override push button.
- c. Supplied Volume Capacity: 1.1 gal per flush.

3. Concealed Type: Rough brass, exposed parts chrome-plated, wall escutcheon, wheel handle stop.
4. Exposed Type: Chrome-plated, escutcheon, integral screwdriver stop.

D. Urinal Carriers:

1. Manufacturers:

- a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
- b. JOSAM Company: www.josam.com/#sle.
- c. Zurn Industries, LLC: www.zurn.com/#sle.

2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.05 LAVATORIES

A. Manufacturers:

1. American Standard, Inc: www.americanstandard-us.com/#sle.

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2. Kohler Company: www.kohler.com/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.
 4. Just.
- B. Wall-Hung Basin:
1. Vitreous China: ASME A112.19.2; white, rectangular basin with splash lip, front overflow, soap depression, and hanger. Size as indicated on drawings with 4-inch centerset spacing.
 2. Products:
 - a. PROFLO: www.ferguson.com/#sle.
 - b. American Standard.
 - c. Kohler
 3. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs.
 - b. Manufacturers:
 - 1) Jay R. Smith MFG. Co; _____: www.jrsmith.com/#sle.
 - 2) JOSAM Company; _____: www.josam.com/#sle.
 - 3) Zurn Water, LLC; Z1231: www.zurn.com/#sle.
- C. Drop-In Basin:
1. Vitreous China: ASME A112.19.2; self-rimming, white, rectangular shape, front overflow, soap depression, seal of putty, caulking, or concealed vinyl gasket, and white finish. Size as indicated on drawings with 4-inch centerset spacing.
 2. Products:
 - a. PROFLO; Rockaway - 19 x 16, Oval: www.ferguson.com/#sle.
- D. Supply Faucet:
1. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 0.5 gpm, see fixture schedule for more details..
- E. Sensor Operated Faucet:
1. Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
 2. Spout Style: Standard.
 3. Power Supply (see fixture schedule):
 - a. Wired: 6 VDC, field-wired into dedicated or common power supply.
 - b. Wireless:
 - 1) Battery: Replaceable alkaline or lithium type with 200,000 cycles, minimum.
 - 2) Light Cell: Photovoltaic or infra-red cell that transforms both sunlight and artificial light into electrical energy for use and battery charging.
 - 3) Mini-Turbine: Sensor-operated hydro-powered micro-turbine that charges battery and powers mechanism using water flow energy.
 - 4) Low Battery Warning: Provide red or yellow colored indicator to light periodically at 30 days of remaining capacity and continuously 2 weeks prior to get fully discharged.
 4. Mixing Valve: None, single line for tempered water.
 5. Water Supply: 3/8 inch compression connections.
 6. Aerator: Vandal resistant, 0.5 gpm, laminar flow device.
 7. Automatic Shut-off: 30 seconds.
 8. Sensor Range: Factory set at 3 inch adjustable up to 24 inch.

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9. Finish: Polished chrome.
10. Accessory: 4 inch deck plate.
11. Manufacturers:
 - a. Chicago Faucet Company; _____: www.chicagofaucets.com/#sle.
 - b. Moen Incorporated; _____: www.moen.com/#sle.
 - c. Sloan Valve Company; _____: www.sloanvalve.com/#sle.
 - d. Toto USA; _____: www.totousa.com/#sle.
 - e. Watts; _____: www.watts.com/#sle.
 - f. Zurn Water, LLC: www.zurn.com/#sle.

- F. Thermostatic Mixing Valve:
 1. ASSE 1070 water temperature limiting valve.
 2. See Section 22 11 19 for mixing valve specifications.
- G. Accessories:
 1. Offset waste with perforated open strainer.
 2. Wheel handle stops.
 3. Rigid supplies.

2.06 SINKS

- A. Manufacturers:
 1. American Standard, Inc: www.americanstandard-us.com/#sle.
 2. Kohler Company: www.kohler.com/#sle.
 3. Just.
 4. J.R. Smith Manufacturing Company
- B. See Fixture Schedule for more details.
- C. Single Compartment Bowl
 1. 18 thick, type 304 stainless steel, self-rimming and undercoated, with ledge back drilled for trim.
 2. Drain: 1-1/2 inch chromed brass.
 3. Drain: 3-1/2 inch crumb cup and tailpiece.
- D. Double Compartment Bowl:
 1. 18 gauge, 0.050 inch thick, type 304 stainless steel, self-rimming and undercoated, with ledge back drilled for trim.
 2. Drain: 1-1/2 inch chromed brass.
 3. Drain: 3-1/2 inch crumb cup and tailpiece.
- E. Faucets:
 1. Manufacturers:
 - a. American Standard: www.americanstandard-us.com/#sle
 - b. Kohler Company: www.kohler.com/#sle.
 - c. PROFLO; _____: www.ferguson.com/#sle.
 2. Single Handle Faucet:
 - a. Type: Deck-mount pre-rinse, low-arc, swivel spout faucet with mounting plate.
 - b. Type: Deck-mount, low-arc, swivel faucet with mounting plate.
 - c. Spray Type: Full stream spray at 1.5 gpm, maximum.
 - d. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.
 - e. Materials: Ceramic disc-cartridge valve on brass body with polished chrome finish.

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- F. Accessories: Provide braided water supply lines, slip-joint p-trap, and stainless steel basket strainer.

2.07 UNDER-LAVATORY PIPE SUPPLY COVERS

- A. Manufacturers:
 - 1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
 - 2. McGuire.
- B. General:
 - 1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
 - 2. Adhesives, sewing threads and two ply laminated materials are prohibited.
 - 3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
 - 4. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Provide one piece injected molded design with internal bridge at top of J-bend to prevent separating.
 - b. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - c. Comply with ICC A117.1.
 - 5. Color: High gloss white.
 - 6. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

2.08 ELECTRIC WATER COOLERS

- A. Manufacturers:
 - 1. Elkay Manufacturing Company: www.elkay.com/#sle.
 - 2. Haws Corporation: www.hawsco.com/#sle.
 - 3. Oasis International: www.oasiscoolers.com/#sle.
 - 4. Halsey-Taylor.
- B. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
 - 1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
 - 2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.
- C. Bottle Filler: Materials to match fountain.
- D. Products:
 - 1. Oasis International; _____: www.oasiscoolers.com/#sle.
 - 2. Halsey Taylor.
 - 3. Elkay.

2.09 BI-LEVEL, ELECTRIC WATER COOLERS

- A. Manufacturers:
 - 1. Elkay Manufacturing Company; _____: www.elkay.com/#sle.
 - 2. Haws Corporation; _____: www.hawsco.com/#sle.
 - 3. Oasis International; _____: www.oasiscoolers.com/#sle.

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4. Halsey-Taylor.
 - B. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
 1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
 2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.
 - C. Bottle Filler: Materials to match fountain.
 - D. Products:
 1. Haws Corporation; Dual Wall Mount Fountains: www.hawsco.com/#sle.
 2. Oasis International; _____: www.oasiscoolers.com/#sle.
 3. Elkay.
- 2.10 MOP SINKS
- A. Manufacturers:
 1. Acorn Engineering Company; _____: www.acorneng.com/#sle.
 2. Just Manufacturing Company; _____: www.justmfg.com/#sle.
 3. Zurn Water, LLC: www.zurn.com/#sle.
 - B. Material: Precast terrazzo composed of marble chips cast in Portland cement. Color by Architect from standard colors.
 - C. Type: Rectilinear, standard height.
 - D. Tiling Flange Construction: Galvanized steel.
 - E. Grid strainer: Stainless steel; integral; removable.
 - F. Dimensions: As indicated on drawings.
 - G. Accessories:
 1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
 2. Hose clamp hanger.
 3. Mop hanger.
- 2.11 UTILITY SINKS
- A. Manufacturers:
 1. Acorn Engineering Company: www.acorneng.com/#sle.
 2. American Standard, Inc: www.americanstandard-us.com/#sle.
 3. Elkay Manufacturing Company; _____: www.elkay.com/#sle.
 4. Gerber Plumbing Fixtures LLC; _____: www.gerberonline.com/#sle.
 5. Just Manufacturing Company: www.justmfg.com/#sle.
 6. PROFLO; Double Bowl Sink with Legs: www.ferguson.com/#sle.
 7. Zurn Industries.
 - B. See Fixture Schedule for more details.
- 2.12 EMERGENCY SHOWER
- A. Manufacturers:
 1. Haws Corporation: www.hawsco.com/#sle.

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2. Bradley.
 3. Guardian.
 4. Speakman
- B. Emergency Shower: ANSI Z358.1; free standing, self- cleaning, nonclogging 8 inch diameter stainless steel deluge shower head with elbow, one inch full flow valve with pull chain and 8 inch diameter ring, one inch interconnecting fittings.
- C. Provide combination eye/face wash and shower unit, with details per eye/face wash above.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify walls, floors, and finishes are prepared and ready for installation of fixtures.
- B. Verify rough-ins for field connections match sizes and locations shown on drawings.
- C. Verify electric power is available and of the correct characteristics.
- D. Verify casework and countertops are prepared and ready for installation of fixtures.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install components level and plumb.
- C. Secure fixtures in place.
- D. Install rigid or flexible supplies to fixtures. Provide supply stops, reducers, and escutcheons.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Repair or replace damaged or defective products.
- D. Test fixtures after installation to verify operation. Correct deficiencies.
- E. Install and secure fixtures in place with wall carriers and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant as specified, color to match fixture.

3.04 ADJUSTING

- A. Adjust stops and valves so fixtures operate without splashing, noise, or overflow.
- B. Adjust sensor range on sensor-operated fixtures.

3.05 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Clean plumbing fixtures to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

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3.06 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.

3.07 FIXTURE HEIGHTS

- A. Install fixtures to heights above finished floor as indicated in Architectural specifications and on Engineer/Architectural drawings.

END OF SECTION 22 40 00

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SECTION 22 40 17 - BATHTUBS AND SHOWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Showers.
- B. Bathtub and shower faucets, valves, and trim.

1.02 RELATED REQUIREMENTS

- A. Section 22 11 19 - Domestic Water Piping Specialties.
- B. Section 22 30 00 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.18.1 - Plumbing Supply Fittings; 2024.
- C. ASME A112.18.2 - Plumbing Waste Fittings; 2020 (Reaffirmed 2025).
- D. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2020.
- E. ASSE 1016 - Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations; 2017 (Reaffirmed 2021).
- F. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- G. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- I. NSF 61 - Drinking Water System Components - Health Effects; 2025, with Addendum
- J. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include materials of fabrication, rough-in requirements, location and sizes of connections, configurations, dimensions, finishes, features, and accessories.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- C. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

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- D. Store products indoors in clean, dry area. Protect from water and dirt. Elevate above floor.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide supply fixtures, fittings, valves, and trim certified as complying with NSF 61 and NSF 372.
- B. ADA: Where indicated to be ADA-compliant, provide fixtures complying with ADA Standards and ICC A117.1.
- C. Maximum Fixture and Faucet Supply Pressure: 80 psi unless stated otherwise.

2.02 SHOWERS

- A. Manufacturers:
 - 1. Accessibility Professionals: www.accessibilitypro.com/#sle.
 - 2. American Bath Group: www.americanbathgroup.com/#sle.
 - 3. Best Bath Systems: www.bestbath.com/#sle.
 - 4. _____.
- B. Acrylic and Fiberglass Showers: IAPMO Z124, molded cast acrylic or reinforced glass fiber with acrylic or gel overlay, with slip-resistant surface.
- C. Shower Reinforcing: Factory-installed full plywood backing for grab bar placement.
- D. Drains: Provide ASME A112.18.2, NPS 2 drain and p-trap.
- E. Accessories:
 - 1. Folding Seat: Factory or field installed to meet ADA Standards and ICC A117.1.
 - 2. Grab Bars: Manufacturer provided in quantity, size, and locations to meet ADA Standards and ICC A117.1.

2.03 BATHTUB AND SHOWER FAUCETS, VALVES, AND TRIM

- A. Shower Valves and Trim:
 - 1. Manufacturers:
 - a. American Standard: www.americanstandard-us.com/#sle
 - b. PROFLO: www.ferguson.com/#sle.
 - 2. Assembly: ASME A112.18.1, with control valve, shower head, and arm.
 - 3. Control Valve: ASSE 1016, combination thermostatic and pressure-balancing, brass or bronze body with inlet checkstops; integral volume and temperature control with adjustable high-temperature limit stop.
 - 4. Finish: Chrome.
 - 5. Flow Rate: Maximum 2.0 gpm at 80 psi.
 - 6. Accessory Hand Shower: Provide with ASSE 1014 backflow preventer and hose. Provide diverter valve. Provide hand shower and hose in finish to match shower trim.
 - a. Hand Shower Mounting:
 - 1) Wall bracket.

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- 2) Mounting Bar: Minimum 24-inch long wall bar with adjustable slide.
- 3) Grab Bar: ADA-compliant, 36-inch long grab bar with adjustable slide.
7. Products:
 - a. PROFLO; PF7610GCP: www.ferguson.com/#sle.
- B. Hand Showers:
 1. Assembly: ASME A112.18.1 with shower wand, wall supply elbow, hose, and ASSE 1014 backflow preventer.
 2. Control Valve: ASSE 1016, pressure balancing, brass or bronze body with inlet checkstops; integral volume and temperature control with adjustable high-temperature limit stop.
 3. Finish: Chrome.
 4. Hose: Minimum 60-inch flexible metal hose in finish to match shower wand.
 5. Flow Rate: Maximum 2.0 gpm at 80 psi.
 6. Hand Shower Mounting:
 - a. Wall bracket.
 - b. Mounting Bar: Minimum 24-inch long wall bar with adjustable slide.
 - c. Grab Bar: ADA-compliant, 36-inch long grab bar with adjustable slide.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify walls, floors, and finishes are prepared and ready for installation of fixtures.
- B. Verify rough-ins for field connections match sizes and locations shown on drawings.
- C. Verify electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install products level and plumb.
- C. Secure fixtures in place.
- D. Install ball valves in hot- and cold-water piping to fixtures if supply stops have not been specified or provided. Locate ball valves in accessible locations.
 1. See Section 22 05 23 for ball valve specifications.
- E. Install wall-mounted fixtures, trim, and accessories at heights indicated on drawings.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect each product for damage and defects.
- C. Repair or replace damaged or defective products.
- D. Test fixtures after installation to verify operation. Correct deficiencies.

3.04 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

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- B. Clean fixtures to remove dirt, fingerprints, paint, and other foreign material. Restore finishes to match original factory finish.

3.05 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.

END OF SECTION 22 40 17

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SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hand-held emergency drench hose.
- B. Safety stations (combination emergency fixture units).
- C. Emergency-fixture water-tempering valves.

1.02 REFERENCE STANDARDS

- A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014, with Editorial Revision (2020).
- B. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
- C. ASSE 1071 - Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment; 2012 (Reaffirmed 2021).
- D. UL (DIR) - Online Certifications Directory; Current Edition.

PART 2 PRODUCTS

2.01 HAND-HELD EMERGENCY DRENCH HOSE

- A. Manufacturers:
 - 1. Guardian Equipment; _____: www.gesafety.com/#sle.
 - 2. Haws Corporation; _____: www.hawesco.com/#sle.
- B. ANSI Z358.1, 15 gallon drench hose with flanged spray head assembly.
- C. Hose:
 - 1. 8 feet long, flexible reinforced PVC with fitted male swivel water connection.
 - 2. Maximum Working Pressure: 275 psi.
- D. Handle: Full flow, self closing, quick to open plastic covered metal lever handle.
- E. Thermostatic Mixing Valve: ASSE 1071, manufacturer furnished, sized for maximum flow rate of drench shower.
- F. Tepid Supply Water Temperature: Set to 85 degrees F.
- G. Accessories:
 - 1. In-line dual backflow preventer fitted to hose inlet.
 - 2. Signage: ANSI Z535.2, emergency drench hose safety equipment.
 - 3. Shut Off Valve: Provide upstream full flow ball valve with detached operating handle.

2.02 SAFETY STATIONS (COMBINATION EMERGENCY FIXTURE UNITS)

- A. Manufacturers:
 - 1. Guardian Equipment; _____: www.gesafety.com/#sle.
 - 2. Haws Corporation; _____: www.hawesco.com/#sle.

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- 3. Speakman Company; _____: www.speakman.com/#sle.
- B. ANSI Z358.1, free-standing shower with bowl-mounted dual eye wash spray head fixture assembly.
- C. Product Certification: UL (DIR).
- D. Tepid Supply Water Temperature: Set to 85 degrees F.
- E. Water Supply Connection Size: Minimum, 1-1/4 inch.
- F. Water Discharge Flow Rates:
 - 1. Shower Head: Minimum, 20 gpm at 30 psi for 15 minutes.
 - 2. Eye wash Spray Heads: Minimum, 0.4 gpm for 15 minutes.
- G. Pipe and Fittings Material: Powder coated galvanized steel.
- H. Shower Head:
 - 1. Self-cleaning, non-clogging, 10 inches in diameter with escutcheon.
 - 2. Flow Pattern: Minimum, 20 inches at 60 inches above floor end.
- I. Freeze Protection: Thermostatically-actuated bleed valve.
- J. Valves: Full flow, self closing, quick to open within one second using dedicated manual panic bar operator for shower and dedicated manual panic bar handle for eye wash.
- K. Accessories:
 - 1. Manually operated, shower head curtain assembly.
 - 2. Bowl Cover: Valve-operated matching material hinged assembly.
 - 3. Signage: ANSI Z535.2, emergency safety station equipment.
 - 4. Eye wash: Provide adjustable spray head flow control and spray head filter.

2.03 EMERGENCY-FIXTURE WATER-TEMPERING SYSTEM

- A. Manufacturers:
- B. Tepid Water Temperature: Set to 85 degrees F.
- C. Capacity: Sized for 300 gpm at 30 psi supply pressure.
- D. Valve Assembly: ASSE 1071, thermostatic mixing valve made of lead-free cast brass body with integral built-in cold water bypass (fail safe), color marked dual-scale outlet temperature gauge, integral inlet check valve, integral inlet strainer, locking-type regulator, and mounting bracket.
- E. Above-freezing, Chemical-resistant System:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fixtures and accessories are of the correct type and size prior to installation.
- B. Verify that deck, wall and floor finishes are prepared and ready for fixture installation.

3.02 INSTALLATION

- A. Install fixtures and fittings in accordance with the manufacturer's instructions.
- B. Adjust water flow rates to comply with manufacturer's rating of the fixture.

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- C. Place remote-activated thermostatically actuated bleed valve behind wall or buried below frost line.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.04 CLEANING

- A. Thoroughly clean plumbing fixtures and equipment.

3.05 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION 22 45 00

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SECTION 23 05 00 - HVAC GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

- A. Provide and coordinate all plans, labor, materials, apparatus, services, and equipment required for the installation of a fully operational HVAC system as shown in the contract documents.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 23.
- B. Applicable Codes, Regulations and Standards:
 - 1. Latest Edition of the North Carolina State Building Code.
 - 2. Applicable National Fire Protection Association (NFPA) Codes.
 - 3. Applicable Underwriters Laboratory (UL) Standards. All electrical materials and equipment shall be UL listed and labeled in every case where such listing has been established.
 - 4. Latest Edition of the National Electrical Code (NEC, NFPA 70).
 - 5. Latest Edition of the National Electrical Manufacturers' Association (NEMA) Standards.
 - 6. Latest Edition of American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

1.03 SUMMARY

- A. This Section includes general administrative and procedural requirements for HVAC installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in the general conditions.
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Maintenance manuals.
 - 5. Rough-ins.
 - 6. HVAC installations.
- B. Related Sections:
 - 1. Specification Section 230513 "Electrical Requirements for HVAC Equipment", for factory-installed motors, disconnects, motor starters, controllers, accessories and connections.
 - 2. The drawings accompanying this specification are generally diagrammatic and do not show all details required for the complete system. They should however be followed as closely as possible in the general arrangement and location of equipment. Do not scale the drawings. Check all dimensions at the building and investigate all structural and finish conditions. Arrange all work to meet these conditions and provide such offsets, brackets and other necessary accessories as may be required.

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3. Immediately upon discovery of any discrepancy in the drawings or the specifications, or points of conflict therein, notify the Engineer who will clarify such discrepancy in writing prior to the progress of the work beyond the point concerned.
4. Do not cover up construction until it has been inspected and approved by the Engineer.

1.04 SUBMITTALS

- A. General: Follow the procedures specified in Division 1.
- B. Increase, by the quantity listed below, the number of HVAC related shop drawings, product data, and samples submitted, to allow for required distribution plus one copy of each submittal required, which will be retained by the Engineer. One additional copy of the shop drawings shall be submitted for Wake County Public School System Quality Control Review.
 1. Shop Drawings - 2 additional blue - or black-line prints.
 2. Product Data - 1 additional copy of each item.
- C. Additional copies may be required by individual sections of these specifications. Upon completion of the project, provide the Owner with a complete set of all shop drawings and submittals as outlined in Paragraph D of this Section.
- D. Shop Drawings and Catalog Data: Approval of submittals for any material, apparatus, devices and layouts shall not relieve the Contractor from the responsibility of furnishing same as specified of proper dimensions, size and quantity. If the submittals deviate from the contract documents in these three areas, advise the Engineer of the deviations in writing accompanying the shop drawings, including the reason for deviations. Any items found on the job either installed or not installed which do not meet the above criteria shall be replaced by the Contractor at the discretion of the Engineer. Review and stamp all shop drawings and submittals before submitting them to the Engineer for approval. Any submittals not stamped and signed by the Contractor prior to submittal to the Engineer will be returned to the Contractor for his stamp and resubmittal. A copy of all shop drawings and submittals shall be kept at the job site at all times.
 1. Required Submittals:
 - a. Pumps
 - b. Electrical Equipment (including motor starters and disconnects)
 - c. Air Handling Units
 - d. Fans
 - e. Air Filters
 - f. Ductwork
 - g. Ductwork Accessories
 - h. Piping and Accessories
 - i. Air Distribution
 - j. Valves
 - k. Pipe Hangers and Supports
 - l. Piping Insulation and Jacketing
 - m. Ductwork Insulation
 - n. Building Automation System
 - o. Instrumentation
 - p. Mechanical Identification
 - q. Vibration Isolation

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- r. Equipment Insulation
- s. Hydronic Specialties (Balancing Valves, etc.)
- t. Power Ventilators.
- u. Variable Speed Drives
- v. Direct Expansion Split Systems
- w. Electric Unit Heaters
- x. Testing & Balancing

1.05 COORDINATION DRAWINGS

- A. Contractor is required to develop and distribute drawings for coordination with other trades. Drawings shall indicate size and elevation of ductwork and piping for HVAC systems. Conflicts between HVAC system components and devices from other trades shall be brought to the Engineer's attention for resolution.

1.06 RECORD DOCUMENTS

- A. The Contractor shall maintain as-built drawings at the job site and shall submit the drawings to the Engineer at the completion of work. The "As Built" drawings shall indicate the following installed conditions:
 - 1. The location of all equipment.
 - 2. Ductwork mains and branches, size and location, control devices, filters, boxes, and fan coil units.
 - 3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23, Section "Mechanical Identification."
 - 4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 5. Approved substitutions, Contract Modifications, Alternates and actual equipment and materials installed.
- B. During construction operations the Contractor shall faithfully and accurately record all changes from the contract drawings including dimensions where applicable, including invert elevations for all below-grade outside utilities with reference to permanent above-grade objects.
- C. At project close-out, the Contractor shall neatly record with red ink all construction changes on an unused set of contract drawing prints supplied by the Engineer. This set of prints shall be submitted to the Engineer for review and approval. Should the Engineer find these record documents to be incomplete they will be returned to the Contractor and corrected accordingly by the Contractor with no additional cost to the Owner.

1.07 OPERATING AND MAINTENANCE MANUALS

- A. Three (3) complete sets of operating and maintenance manuals shall be submitted to the Owner through the Architect/Engineer two (2) weeks prior to the pre-final inspection date.
- B. The O. & M. Manuals shall be installed in a 3-ring heavy back note book with the name of the building and the words "Operations and Maintenance Manuals" on the cover and spine. The manuals shall contain the following items as a minimum:
 - 1. Index and page numbers.

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2. Certificate of substantial completion.
3. All warranties.
4. List of all subcontractors and suppliers with names, addresses and phone numbers.
5. Certified testing and balancing report.
6. Complete start-up operation, and shut-down procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items.
7. Lubrication schedules and types of lubricants.
8. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
9. Equipment summary showing all capacities and ratings. (HP, Tons, KW, Filter size, etc.)
10. All submittal data and shop drawings.
11. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
12. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown and emergency instructions; summer and winter operating instructions.
13. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair and reassembly; aligning and adjusting instructions.
14. Wiring and control diagrams.
15. Manufacturer's cuts, part numbers and serial numbers.
16. A print of the main electrical control diagrams on non-fading paper shall be wall mounted under glass in each mechanical room. Show control sequence on the diagrams.

1.08 FINAL INSPECTIONS

- A. Each project shall have both a pre-final and final inspection made before it is finally accepted by the Owner. A complete thorough training session shall be conducted by this Contractor and all applicable Subcontractors for the Wake County Public School System after the pre-final inspection.
- B. The pre-final inspection shall be held after all systems are in place and in operation. The HVAC Contractor shall demonstrate to the Engineer and Owner that all systems in the building are properly installed, balanced, and performing as designed and specified. All Contractors and Subcontractors shall attend this inspection including HVAC and air and water balance Subcontractor.
- C. The final inspection shall be held with the Owner, Architect/Engineer, all Contractors and Subcontractors to demonstrate to the Owner that all systems in the building are operating as designed and to their satisfaction.

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1.09 POST INSPECTIONS

- A. Two post construction inspections shall be held by the Architect/Engineer with the Contractors and Owner to assure that the building is continuing to operate in accordance with the plans and specifications and that no unusual problems are occurring in the building systems. The first post construction inspection will be held approximately six months after substantial completion. This inspection will address Plumbing, HVAC and Electrical work. The second post construction inspection shall be held prior to expiration of the 1 year warranty period.
- B. It shall address General Construction as well as Plumbing, HVAC and Electrical work. All problems discovered during these inspections that relate to defective materials or defective workmanship shall be corrected by the responsible Contractor at no additional cost to the Owner.

1.10 WARRANTIES

- A. All work shall be fully warranted for one year from the date of substantial completion by the Contractor who shall replace any defective materials and repair any defective workmanship.

1.11 TEST REPORTS

- A. All systems are required to be tested and shall be documented in writing, listing date, item tests, section tested, witnesses to the test (signed), and specification section which requires testing. Reports on testing shall be submitted within seven (7) days of completion of each test. In addition all test reports shall be compiled in a spiral bound 8 1/2" x 11" document and submitted at the same time and in the same quantity as required for Operation and Maintenance manuals.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver the products to the project properly identified with names, model numbers, types, grades, compliance labels and other information needed for identification. All equipment and materials shall be fully protected and covered with protective materials to prevent any damage.

1.13 PRODUCT SELECTION

- A. Where three or more manufacturers are listed for an item of equipment without an "or approved equivalent" clause, the Contractor may, at his option, provide any one of those specified. Equipment by manufacturers other than those listed will not be considered.
- B. Where one or more manufacturers and a substitutions clause are listed for an item of equipment the Contractor may, at his option, provide the specified item or propose a substitute item of equal quality and performance. Submit a request for substitution for any manufacturer not named. Refer to Section II below regarding substitutions. The Engineer shall determine whether a substitute item is equivalent to the product specified and reserves the right to reject that substitute item.
- C. All materials and equipment specified and shown on the plans shall be new and free from any defects. Each item of equipment shall bear the manufacturer's name or trade mark.
- D. Dimensions: Insure that all items of equipment furnished fit the space available. Make necessary field measurements to ascertain space requirement.

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- E. Subcontractors and materials list: Provide within 5 days after execution of the contract a complete list of proposed Subcontractors and materials including manufacturer's name.

1.14 PRODUCT SUBSTITUTIONS

- A. Engineer will consider requests for Product Substitutions in accordance with Division 1 of this specification.
- B. Product Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Product Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds that quality level of the specified product.
 - 2. Will provide the same warranty for the Substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitutions Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 - 3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUPERVISION

- A. The Contractor shall have a thoroughly competent foreman in charge of the construction work at all times. The foreman shall have extensive experience in the work to be performed.

3.02 ROUGH-IN OF DEVICES

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

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3.03 COORDINATION

- A. General: Sequence, coordinate, and integrate the various elements of HVAC systems, materials, and equipment with work of all other Contractors on the project. Comply with the following requirements:
 - 1. Coordinate HVAC systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction to allow for HVAC installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

3.04 WORKMANSHIP

- A. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- B. Install HVAC equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- C. Duct and pipe penetrations: Duct and pipe penetrations shall be provided by the Mechanical Contractor. Mechanical shop drawings shall be provided to the Architect/Engineer and General Contractor with ALL duct and pipe penetrations sized and located. These shop drawings shall be submitted during early phases of construction so not to delay the General Construction Schedule. Any additional costs, associated with the construction delays, that result from a failure to coordinate this work will be paid by the Mechanical Contractor.
- D. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- E. Properly support all work and equipment installed under this contract. Study all drawings, shop drawings and catalog data to determine how equipment, accessories, piping, and related items are to be supported, mounted or suspended. Provide all bolts, inserts, pipe stands, brackets, structural supports and accessories for proper support of equipment furnished under this contract.

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- F. Provide suitable vibration isolating bases or suspension systems as indicated and/or required for all rotating, reciprocating and vibrating equipment. Design all isolation for maximum absorption efficiency so that no transmission of vibration or structurally borne noise shall occur. The selection of isolators for proper loading to obtain the desired efficiency shall be the responsibility of the manufacturer of the isolating units and shall be fully guaranteed by the manufacturer.
- G. Fire Barrier Penetrations: Where HVAC work passes through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Provide penetration seal materials in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction.
- H. Under no circumstances shall any air handling system be used as a source of temporary heat or cooling until the building is closed in and has progressed to the point where no dust or debris are on the premises served by the air handling system. The building at this point should be free of debris, broom cleaned and closed off by the General Contractor to any other portion of the building in which work is in progress. The HVAC Contractor shall contract the Architect/Engineer seven (7) days in advance of using any permanent HVAC system for temporary cooling or heating. 2" wide 30% efficient throwaway filters shall be installed in all air handling equipment while supplying temporary heat or cooling. Filters shall be maintained and changed as needed to prevent unloading of dust and dirt into the air distribution system. Filters shall be removed upon completion of the work and new operating filters installed.
- I. All mechanical piping systems shall be thoroughly cleaned and flushed prior to their use for temporary cooling or heating. The HVAC Contractor shall contact the Architect/Engineer seven (7) days in advance of cleaning and flushing any mechanical piping systems. As the building is closed in, the HVAC Contractor shall be responsible for providing temporary cooling or heating through the permanent building system as required for general construction activities. This will require utilizing some portions of the mechanical piping systems and isolating others. Isolation of systems shall be accomplished through valves provided in the project. As general construction progresses, closed portions of the mechanical piping systems shall be opened to provide the necessary temporary heating or cooling. Each time a new portion of mechanical piping is opened to clean operating water system, the entire system shall be flushed and cleaned.
- J. The HVAC Contractor shall include in his bid a price to clean and flush the heating hot water and chilled water systems or loop water system three (3) separate times in accordance with Specification Section 232113 and 232500.
- K. All field painting of HVAC work, with exception of touch-up paint on factory finished equipment and exposed double wall spiral duct, shall be by HVAC Contractor in accordance with the "Painting" section of these specifications and Section 23 05 53. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat, and shall be repainted if necessary.

END OF SECTION 23 05 00

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SECTION 23 05 01 - DIVISION OF WORK

PART 1 - GENERAL

1.01 DIVISION OF WORK

- A. This section delineates the division of work between Divisions 23 (Mechanical) and Division 26 (Electrical).
- B. This Contractor shall be responsible for the final electrical and the entire control connections and wiring to all equipment installed as part of his contract.
- C. Contractor shall review the electrical plans, where applicable, to establish points of connection and the extent of his electrical work to be provided in his contract.
- D. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Electrical Contractor or as required by the existing conditions.
- E. All power and control wiring shall be in conduits. Refer to electrical specifications for conduit and conduit fittings.
- F. All electrical work shall be performed by a licensed electrician.
- G. All electrical work shall be in accordance with the State Building Code and all its supplements, the latest edition of the National Electrical Code and the electrical specifications.
- H. All other work necessary for the operation of Division 23 equipment shall be performed under Divisions 23.

PART 2 - PRODUCT

2.01 GENERAL REQUIREMENTS

- A. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.
- B. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.
- C. All conductors and conduits shall be sized as noted on the plans or As required per NEC.
- D. All individual motor starters and drives for mechanical equipment (i.e., fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated as a part of a motor control center. Motor starters provided in motor control centers and at motor control troughs shall be furnished under Divisions 26.
- E. Under Division 26, power wiring rough-in shall be provided for junction box, trough, starter or disconnect switch, as required by the specific piece of equipment. Equipment final connections shall be provided under Division 23.

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- F. Equipment less than 110 volt, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches, beyond termination point, and other appurtenances under Divisions 23 shall be furnished, installed and wired under Divisions 23 in accordance with Division 26.
- G. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 23.
- H. Roof exhaust fans with built-in disconnects provided under Division 23 shall be wired under Division 26 to the line side of the disconnect switch. A disconnect switch shall be provided under Division 26 if the fan is not provided with a built-in disconnect switch. In this case, wiring from the switch to the fan shall be under Divisions 23.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.
- B. Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid-Tite" conduit. Connection to other equipment shall be made with rigid conduit.
- C. Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

END OF SECTION 23 05 01

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SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.02 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2026).
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C. NEMA MG 00001 - Motors and Generators; 2024.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.
- C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

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1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.
- B. Leeson Electric Corporation: www.leeson.com/#sle.
- C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.
- D. General Electric.
- E. Marathon

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 3/4 Horsepower: 208/480 volts, three phase, 60 Hz as indicated on the drawings.
- B. Nominal Efficiency:
 - 1. All motors shall be premium efficiency and meet or exceed the requirements of ASHRAE Standard 90.1-2013 and the North Carolina Energy Code.
 - 2. All motors shall conform to the efficiency standard for integral horsepower motors known as 10 CFR Part 431 Subpart B published by the US Department of Energy.
- C. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Motors driven by variable frequency drives (VFDs) shall be inverter duty and have a shaft grounding ring.
- F. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- G. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

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2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.

2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Insulation System: NEMA Class B or better.
- E. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- F. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- H. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.06 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Applications:
 - 1. Commercial:
 - a. DX Fan Coil Unit:
 - 1) Operating Mode: Constant cfm.

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- 2) Input: Motor manufacturer to coordinate control requirements with the control board of the DX fan coil unit and/or specified sequence of operation.
- b. Power Roof Ventilator (PRV):
 - 1) Operating Mode: Constant cfm.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the PRV and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - 4) Options: Remote mount control.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Motors with belt drives shall have adjustable motor mountings. Motor mounts shall have adjustable locking device for fixing motor position.
- E. Motor starters shall be installed as close to the motors they are serving as possible.
- F. Motor starters shall be installed at locations and heights to meet all State requirements and National Electric Code.

END OF SECTION 23 05 13

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SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.02 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Non-manufactured sleeves:
 - 1. Cast Iron or Schedule 40 Steel
- B. Vertical Piping:
 - 1. Sleeve Length: 2 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. Pipe Passing Through Below Grade Foundation Walls or Exterior Walls:
 - 1. Manufactured sleeve-seal system
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

Sleeves and Sleeve Seals for HVAC

Piping

The Wooten Company

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- D. Non-rated interior stud wall Penetrations:
 - 1. Pack annular space with mineral wool and seal tight with caulk
- E. Non-rated interior CMU wall Penetrations:
 - 1. Pack annual space with mineral wool and seal with non-shrink grout.
- F. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Manufacturers:
 - 1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
 - 2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
 - 3. GPT Industries.
- B. Modular Mechanical Sleeve-Seal:
 - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. High Temperature, up to 400 degrees F.
 - e. Low temperature, down to minus 67 degrees F.
 - 5. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
 - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 - 2. Combined packing and seal compound is to match partition fire-resistance hourly rating.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.

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- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
 - 1. Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, and walls. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 - 2. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 23 05 17

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SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2025.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- J. FM (AG) - FM Approval Guide; Current Edition.
- K. MFMA-4 - Metal Framing Standards Publication; 2004.
- L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- M. UL (DIR) - Online Certifications Directory; Current Edition.
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

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4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.
- 1.04 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Prefabricated Trapeze-Framed Metal Strut Systems:
1. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
 2. Strut Channel or Bracket Material:
 3. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- C. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
- D. Cable Hanging System Kits FOR EXPOSED DUCTWORK:
1. Provide cable-wire in bulk or precut lengths with respective cable hangers as required to hold minimum weight of 120 lb.

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2. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.
- E. Pipe Supports:
 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 3. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
- F. Beam Clamps:
 1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.
 7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- G. Riser Clamps:
 1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- H. Pipe Hangers:
 1. Clevis Hangers, Adjustable:
 - a. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
- I. Pipe Alignment Guides:
 1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
 2. Pipe Sizes 10 inch and Larger: Roller type.
- J. Pipe Shields for Insulated Piping:
 1. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.

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- d. Minimum Service Temperature: Minus 40 degrees F.
 - e. Maximum Service Temperature: 178 degrees F.
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- K. Anchors and Fasteners:
- 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- L. Pipe Installation Accessories:
- 1. Copper Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation; _____: www.holdrite.com/#sle.
 - 2. Thermal Insulated, Surface-Mounted Pipe Supports:
 - a. Manufacturers:
 - 1) FNW; 7701: www.fnw.com/#sle.
 - 2) HoldRite, a brand of Reliance Worldwide Corporation; _____: www.holdrite.com/#sle.
 - b. Material: Carbon steel with epoxy copper or zinc finish.
 - c. Weather and UV light resistant foam, plastic, or rubber material with built-in strut. Maximum Load: 50 lb for single pipe or multiple landed on top strut.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- G. Secure fasteners according to manufacturer's recommended torque settings.
- H. Remove temporary supports.

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3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 23 05 29

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SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.
- D. Section 03 30 00 - Cast-in-Place Concrete.

1.02 DEFINITIONS

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- C. Shop Drawings - Vibration Isolation Systems:

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1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 1. Select vibration isolators to provide required static deflection.
 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
- D. Equipment Isolation: Isolate all motor driven mechanical equipment, unless otherwise noted, from building structure, and from systems which they serve, to prevent equipment vibrations from being transmitted to structure. Unless specifically indicated, follow the latest edition of ASHRAE Application Handbook - Sound and Vibration Control, or manufacturer's recommendations for isolator selection, whichever is more stringent.
 1. Select and locate isolators to produce uniform loading and deflection. Use a minimum of 4 isolators to support each piece of equipment.
 2. Select vibration isolation devices based on the lowest operating speed of equipment.
- E. Piping Isolation:
 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.

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3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Vibration-Isolated Concrete Inertia Bases:
 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 2. Minimum Base Depth: 6 inches.
 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 03 30 00.

2.03 VIBRATION ISOLATORS

- A. Manufacturers:
 1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 - d. Vibro-Acoustics: www.vibro-acoustics.com/#sle.
 - e. The VMC Group/Amber Booth.
 2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
- C. Vibration Isolators for Nonseismic Applications:
 1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
 2. Resilient Material Isolator Mounts, Nonseismic:

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- a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
 - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
 - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Nonseismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

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2.04 ACOUSTICAL AND VIBRATION ISOLATORS

- A. General Requirements:
 - 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 6. Adjust isolators to be free of isolation short circuits during normal operation.
 - 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

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- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 23 05 48

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SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Ceiling tacks.
- F. Section 09 91 23 - Interior Painting: Identification painting.

1.02 REFERENCE STANDARDS

- A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Automatic Controls: Tags. Key to control schematic.
- C. Control Panels: Nameplates.
- D. Dampers: Ceiling tacks, where located above lay-in ceiling.
- E. Ductwork: Stencilled painting.
- F. Heat Transfer Equipment: Nameplates.
- G. Instrumentation: Tags.
- H. Major Control Components: Nameplates.
- I. Piping: Pipe markers.
- J. Relays: Tags.
- K. Small-sized Equipment: Tags.

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- L. Thermostats: Nameplates.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
- B. Letter Color: Black.
- C. Letter Height: 1/4 inch.
- D. Background Color: White.
- E. Plastic: Comply with ASTM D709.

2.03 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
 - 2. Brady Corporation: www.bradycorp.com/#sle.
 - 3. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 6. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.

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6. Ductwork and Equipment: 2-1/2 inch high letters.

C. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com/#sle.
2. Brimar Industries, Inc: www.pipemarker.com/#sle.
3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

2.06 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

2.07 CEILING GRID LABELS

A. Label each device or valve above the ceiling and label the ceiling grid below each. Indicate the type of device or valve and its associated service (e.g. "Shutoff Valve – HW", "VAV-21").

B. Provide custom printed labels for each device, either vinyl or polypropylene, suitable for indoor / outdoor applications. Use portable printer equal to Brady HandiMark Portable Industrial Labeling System.

C. Labels shall be no more than 1-inch in height. Lettering shall be minimum 18-point font. Lettering shall be black on white tape.

D. Provide a list of devices and valves labeled with the identical information in the O&M Manuals.

E. Submit samples of markings on three different devices for approval of the Owner and Engineer.

F. Ceiling grid markers shall be the color listed below:

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Ceiling grid markers shall be the color as indicated below. Beside all colored grid markers, a printed label shall be used to specify what the color marker is locating. Labels shall be no more than 1-inch in height. Lettering shall be minimum 18-point font. Lettering shall be black on white tape.

<u>Sample</u>	<u>Color</u>	<u>Item Marker is Identifying</u>
	Neon Red	Electrical – Pull Box/Future/Disconnects, etc.
	Neon Yellow	Mechanical-Equipment/Fan/Dampers, etc.
	Neon Green	Camera Drops
	Neon Orange	Wireless Access Point
	Blue	Domestic Cold Water-Valves/Arrestor, etc. Chilled Water-Valves, tc.
	Yellow	Gas – Valves/Regulators, etc.
	Green	Domestic Hot Water-Valves, etc. Heating Hot Water-Valves, etc.
	Red	Fire Alarm/Sprinklers/Life Safety

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 91 23.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

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- G. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- H. All piping and duct shall be labeled at least once in EVERY room. Piping and ductwork shall be labeled every 15 ft and at every change of direction.
- I. All exposed mechanical piping in mechanical rooms, boiler rooms, on and above mezzanine levels, both insulated and uninsulated, shall be color coded with 30 mil PVC jacketing per the following schedule:

Makeup Water	Green
Condenser Water	Light Blue
Refrigerant	Gray

- J. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.
- K. Identify control panels, manual motor starters, combination motor starters, disconnects, variable frequency drives, boiler override switches, boiler emergency switches, and major control components outside panels with plastic nameplates.
- L. Identify thermostats or temperature sensors relating to air handling units or valves with labels.
- M. Identify valves in main and branch piping with valve labels.
- N. Tag automatic controls, instruments, and relays. Key to control schematic.
- O. Identify air handling units with plastic nameplates indicating unit number, area served, OEM and external static pressure, based on actual equipment submittal data, number and size of filters, and number and size of belts (where applicable).
- P. Identify fans with plastic nameplates indicating fan number, area served, date of substantial completion and capacity in CFM and Static Pressure and number and size of belts if applicable. Indicate as Direct Drive if Direct Drive.
- Q. Identify pumps with plastic nameplates indicating pump number, system served, GPM, and feet of head.
- R. Provide ceiling track markers to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Markers shall be installed prior to request for above ceiling inspection.

3.03 SCHEDULE

- A. Standard Color Identification for Mechanical Piping (all labels shall be provided with flow arrows):

Chilled Water Supply/Return	CHWS/CHWR	White Lettering/ Blue Background
Hot Water Supply/Return	HWS/HWR	White Lettering/Red Background
Makeup Water	MUW	White Lettering/Green Background

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Fuel Gas Piping	GAS	Black Lettering/Yellow Background
Condensate Drain	COND	Black Lettering/White Background
Refrigerant	REF	Black Lettering/Yellow Background

- B. Standard Color Identification for Ductwork (all labels shall be provided with flow arrows):

Supply Air	SUPPLY	Black Lettering
Return	RETURN	Black Lettering
Outside Air	OUTSIDE AIR	Black Lettering
General Exhaust	EXHAUST	Black Lettering
Fume Hood Exhaust	FUME EXH	Black Lettering

END OF SECTION 23 05 53

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SECTION 23 05 70 - MECHANICAL COORDINATION DRAWINGS/MODEL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The Mechanical Contractor shall be responsible for providing ¼ scale coordination drawings for the entire project, format shall be as stated below.
- B. The drawings shall cover above ceiling space, mechanical rooms, electrical rooms and service yards.
- C. The Building MEP systems shall be modeled at Level of Development (LOD) 300 in accordance with the 2019 Level of Development Specification Part 1 & Commentary as published by the BIM Forum.

PART 2 PRODUCTS - NOT USED PART 3 EXECUTION

2.01 COORDINATION (REVIT)

- A. The Mechanical Contractor shall obtain the architectural, structural, and MEP REVIT models from the Architect. The models will be in REVIT 2024.
- B. The Mechanical Contractor shall produce drawings that indicate all piping, equipment and ductwork on 1/4" scale drawings. All items shall be drawn to scale, dimensioned and be easily identified. The drawings shall indicate a bottom of duct or bottom of pipe.
- C. The Mechanical Contractor shall obtain the Structural model containing the actual structural members being provided on the project from the General Contractor/Construction Manager and steel supplier.
- D. Where piping, ductwork, or other items are indicated to be routed in the webbing of joists or trusses, the mechanical contractor shall confirm with the General Contractor/Construction Manager and steel supplier the final joist/truss profile prior to fabricating or order materials. The actual final joist/truss profile shall be used in the BIM coordination effort.
- E. The Mechanical Contractor shall import a file compatible with Navisworks from the Plumbing Contractor that indicates all piping and plumbing equipment. This includes underground piping. The drawings shall be to scale, dimensioned and clearly identified. The drawings shall indicate bottom of pipe (or centerline) for all equipment or pipes.
- F. The Mechanical Contractor shall import a file compatible with Navisworks from the Fire Protection Contractor that indicates all piping, heads, and equipment. The drawings shall be to scale, dimensioned and clearly identified. The drawings shall indicate bottom of pipe (or centerline) for all equipment or pipes.
- G. The Mechanical Contractor shall import a file compatible with Navisworks from the Electrical Contractor that indicate all conduits over 2", lights, cable tray, underground duct banks and electrical equipment. The drawings shall be to scale, dimensioned and clearly identified. The drawings shall indicate mounting heights of all equipment.

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- H. The Mechanical Contractor shall incorporate the Plumbing Contractor's and the Electrical Contractor's model and drawings with his own model and drawings to make one overall set of coordination drawings for each area. The Mechanical Contractor shall adjust layers, colors, etc., to make the drawing readable.
- I. Navisworks shall be used for clash detection. The Mechanical Contractor shall review the overall coordination model for conflicts. If a conflict is found, the Mechanical Contractor shall coordinate revisions to the plans with each sub contractor. There shall be as many iterations as required to produce a clash-free model
- J. If any problems cannot be worked out between the Contractors, the Mechanical Contractor shall contact the Engineer. At that time, a meeting with the Engineer and the Architect will be arranged. The Mechanical Contractor shall make the overall coordination model available for the meeting.
- K. Once all conflicts have been resolved, the Mechanical Contractor shall provide the Architect and Engineer with a complete set of Coordination Drawings.
 - 1. In addition, the Mechanical Contractor shall send the completed overall coordination drawings to a printer so that the Plumbing, Fire Protection, and Electrical Contractors can order as many copies as they desire (at their expense). The Mechanical Contractor is responsible for providing the Engineer's set, the Architect's set, and the Mechanical Contractor's set(s).
 - 2. The Mechanical Contractor and the General Contractor are responsible for setting the schedule for this process. The Plumbing Contractor, Fire Protection Contractor, Electrical Contractor and the Architect should approve the schedule.
 - 3. The Coordination Drawings shall be used as the basis for the As-Built Drawings/Model. These shall be made available to the Design Team and Owner for this purpose.
 - 4. The overall coordination drawings shall be completed prior to any plumbing, mechanical and electrical work beginning. Start of work, including underground work, without completed Coordination Drawings is at the Contractor's risk.

END OF SECTION 23 05 70

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic and refrigerating systems.
- C. Ductwork Leakage Testing
- D. Commissioning activities.
- E. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- F. Section 23 08 00 - Commissioning of HVAC.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority and HVAC controls contractor.
 - 3. Include at least the following in the plan:
 - a. Indicate standard to be followed (AABC or NEBB)
 - b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Identification and types of measurement instruments to be used and their most recent calibration date.
 - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - f. Final test report forms to be used.
 - g. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.

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- 6) Diversity issues.
 - h. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - l. Method of checking building static and exhaust fan and/or relief damper capacity.
 - m. Time schedule for TAB work to be done in phases (by floor, etc.).
 - n. Description of TAB work for areas to be built out later, if any.
 - o. Time schedule for deferred or seasonal TAB work, if specified.
 - p. False loading of systems to complete TAB work, if specified.
 - q. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - r. Interstitial cavity differential pressure measurements and calculations, if specified.
 - s. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - t. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Field Logs: Submit at least twice a week to the Commissioning Authority and Construction Manager.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit to the Commissioning Provider within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 - 5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 7. Units of Measure: Report data in I-P (inch-pound) units only.

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8. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Report date.
- F. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

1.04 QUALITY ASSURANCE

- A. The TAB agency shall be a subcontractor of the General Contractor (or Construction Manager) and shall report directly to and be paid by the General Contractor.
- B. The TAB agency shall be either a certified member of AABC or NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein.
- C. Any agency that has been the subject of disciplinary action by either the AABC or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
- D. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.
- E. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include:
 1. Shall directly supervise all TAB work.
 2. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.
 3. Would follow all TAB work through its satisfactory completion.
 4. Shall provide final markings of settings of all HVAC adjustment devices.
 5. Permanently mark location of duct test ports.
 6. Shall document critical paths from the fan or pump. These critical paths are ones in which are 100% open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.

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- F. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB

1.05 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee AABC or NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
 - 3. Warranty Period: Five (5) years.

PART 2 PRODUCTS

2.01 PLUGS

- A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.02 INSULATION REPAIR MATERIAL

- A. Refer to individual insulation sections for repair of insulation removed or damaged during TAB work.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

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- F. For each air handling system, provide a graphical static pressure profile indicating the pressure drop across each component of the air handling unit (filter, coils, dampers, wheel, etc).

3.02 PRE-CONSTRUCTION TAB WORK

- A. Coordinate with General Contractor and Owner on scheduling pre-construction TAB measurements work prior to the start of demolition work.
- B. Inspect each existing System to ensure it is operational, including controls. Provide report of any existing deficiencies to the Engineer.
- C. Measurements shall be made to document the existing systems' performance prior to the start of
- D. The data to be measured and recorded for each piece of equipment, coil, etc., shall be the same as listed below for the "New" work.

3.03 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
 - 16. Clean and set automatic fill valves for required system pressure.
 - 17. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
 - 18. Check air vents at high points of systems and determine if all are installed to bleed air completely.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.04 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

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- B. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
- C. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.
- D. Compare design to installed equipment and field installations.
- E. Walk the system to determine variations of installation from design.
- F. Check filters for cleanliness.
- G. Lubricate all motors and bearings.

3.05 ADJUSTMENT TOLERANCES

A. Air System Tolerances

Systems - Air	Tolerances of Drawing Design	Remarks
Air Handling Units, Fans (Supply, Return, Exhaust)	-5% to + 10%	Systems with Filters must be tested at dirty conditions
Outdoor Air	100% to 110%	To obtain this accuracy requires ductwork be traversed
Diffusers and Grilles	+/-10%	If design is less than 100 CFM, tolerance can be +/- 10 CFM

3.06 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. When averaging values, take a sufficient quantity of readings that will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- F. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- G. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- H. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

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- I. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- J. Seal ducts and piping, and test for and repair leaks.
- K. Seal insulation to re-establish integrity of vapor barrier.
- L. Retest, adjust, and balance systems subsequent to significant system modifications and resubmit test results.

3.07 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Test, adjust, and balance the air systems before the hydronic systems.
- C. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- D. Measure air quantities at air inlets and outlets.
- E. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- F. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- G. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- H. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- I. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
 - 1. Artificially load filters by partially blanking to produce static pressure air drop of filter manufacturer's recommended "dirty" pressure drop.
- J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. The TAB report shall indicate the critical VAV box and how the static pressure set point was established.

3.08 DUCTWORK LEAKAGE CRITERIA:

- A. The TAB contractor shall be responsible for conducting and recording ALL duct leakage tests.

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- B. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined in the SMACNA Manual.
- C. Ductwork Sealing: As a minimum standard, ductwork and plenums shall be sealed in accordance with Table 6.2.4.3A of ASHRAE Standard 90.1 (as required to meet the requirements of Section 6.2.4.4 SMACNA Duct Leakage Test Procedures).
- D. Ductwork constructed to 3" w.g. pressure class (positive or negative) or higher shall be leak-tested according to the SMACNA HVAC Air Leakage Test Manual. All sections shall be tested, unless otherwise noted.
- E. The Test Pressure for each system shall be equal to the construction pressure class the respective duct system is constructed to.
- F. Maximum permitted duct leakage shall be:
 - 1. $L_{max} = CL \times \text{Test Pressure "P"}$ raised to the 0.65 power where L_{max} is maximum permitted leakage in CFM/100 sq. ft. duct surface area
 - 2. CL is duct leakage class in cfm/100 sq. ft. at 1-inch w.c., which shall be
 - a. "6" for rectangular sheetmetal, rectangular fibrous ducts, and round flexible ducts.
 - b. "3" for round/flat oval sheetmetal or fibrous glass ducts.
 - 3. P is test pressure, equal to the duct construction pressure class rating in inches w.c.

3.09 CRITICAL FLOW PATH

- A. Provide a documented critical path for all fluid flows. There shall be at least one terminal device that can be traced back to the fan or pump where there is no damper or valves that are less than 100% open.

3.10 DEMONSTRATION

- A. Training
 - 1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Provide four (4) hours on site training. Review with the Owner's personnel the information contained in the Operating and Maintenance Data specified in Division 1 and Section 23 01 00.
 - 2. Schedule training with the Owner through the Engineer with at least 7 days prior notice.

3.11 COMMISSIONING

- A. See Sections 01 91 13 - General Commissioning Requirements and 23 08 00 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.
- D. Furnish to the Commissioning Provider, upon request, any data gathered but not shown in the final TAB report.
- E. In the presence of the Commissioning Provider, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.

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2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.12 SCOPE

- A. Test, adjust, and balance the following:
 1. Plumbing Pumps.
 2. Air Cooled Refrigerant Condensers.
 3. Packaged Terminal Air Conditioning Units.
 4. Air Coils.
 5. Terminal Heat Transfer Units.
 6. Air Handling Units.
 7. Fans.
 8. Air Filters.
 9. Air Inlets and Outlets.
- B. This Section does NOT include:
 1. Testing boilers and pressure vessels for compliance with safety codes.
 2. Specifications for materials for patching mechanical systems.
 3. Specifications for materials and installation of adjusting and balancing; refer to the respective system sections for materials and installation requirements.
 4. Requirements and procedures for piping systems leakage tests.

3.13 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 1. Manufacturer.
 2. Model/Frame.
 3. HP/BHP.
 4. Phase, voltage, amperage; nameplate, actual, no load.
 5. RPM.
 6. Service factor.
 7. Starter size, rating, heater elements.
 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
 1. Identification/location.
 2. Required driven RPM.
 3. Driven sheave, diameter and RPM.
 4. Belt, size and quantity.
 5. Motor sheave diameter and RPM.
 6. Center to center distance, maximum, minimum, and actual.
- C. Air Cooled Condensers:
 1. Identification/number.

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2. Location.
 3. Manufacturer.
 4. Model number.
 5. Serial number.
 6. Entering DB air temperature, design and actual.
 7. Leaving DB air temperature, design and actual.
 8. Number of compressors.
- D. Cooling Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Entering air DB temperature, design and actual.
 7. Entering air WB temperature, design and actual.
 8. Leaving air DB temperature, design and actual.
 9. Leaving air WB temperature, design and actual.
 10. Water flow, design and actual.
 11. Water pressure drop, design and actual.
 12. Entering water temperature, design and actual.
 13. Leaving water temperature, design and actual.
 14. Air pressure drop, design and actual.
- E. Heating Coils:
1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Water flow, design and actual.
 7. Water pressure drop, design and actual.
 8. Entering water temperature, design and actual.
 9. Leaving water temperature, design and actual.
 10. Entering air temperature, design and actual.
 11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- F. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.

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14. Fan RPM.
- G. Return Air/Outside Air:
 1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- H. Exhaust Fans:
 1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.
 11. Fan RPM.
- I. Duct Traverses:
 1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- J. Air Distribution Tests:
 1. Air terminal number.
 2. Room number/location.
 3. Terminal type.
 4. Terminal size.
 5. Design air flow.
 6. Test (final) velocity.
 7. Test (final) air flow.
 8. Percent of design air flow.

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END OF SECTION 23 05 93

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SECTION 23 07 13 - DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
 - 1. Schedule indicating insulation type, thickness, and location for each service
 - 2. Density
 - 3. Compressive Strength
 - 4. "k" value at 75 deg F
 - 5. Nominal "R" value
 - 6. Flame spread rating
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

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- C. Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Owner. Use materials indicated for the completed Work. Mockups shall include piping insulation, ductwork insulation and equipment insulation.
- D. All the ductwork and piping in pump rooms, mechanical rooms and equipment rooms including areas without ceilings is to be considered as exposed piping or ductwork. This also includes penthouses, interstitial spaces, and crawl spaces, where applicable.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.
- C. Insulation shall not be installed until all testing and inspection of pipe, duct, vessel, etc. has been completed and approved by Engineer/Owner's representative.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723. These ratings must be as tested on composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics, and cements must meet the same individual ratings as minimum requirements.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K value: 0.36 at 75 degrees F.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

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3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Mastic:
 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Johns Manville: www.jm.com/#sle.
 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612; rigid, noncombustible.
 1. K Value: 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 450 degrees F.
 3. Maximum Water Vapor Absorption: 5.0 percent.
 4. Maximum Density: 8.0 pcf.
- C. Vapor Barrier Jacket:
 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Finish:
 1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.

2.04 POLYISOCYANURATE INSULATION BOARD

- A. Manufacturer:
 1. Dyplast
 2. Rmax
 3. Johns Manville
 4. Or Approved Equal
- B. Insulation:
 1. Flat Foam Insulation with Heavy Duty Fiber-Reinforced Facers: closed-cell polyisocyanurate foam core laminated to extra durable heavy duty fiber-reinforced facers on both sides; conforming to ASTM C 1289, Type II, Class 2.
 2. Blowing Agent: Zero ODP, 3rd generation.
 3. Thickness 2.00 inch, R Value 11.4, flute spanability 4-3/8 inches
 4. 25/450 flame/smoke spread rating
- C. Vapor Barrier Jacket:
 1. Asphalt Bitumen: ASTM D 312, Type III, or Type IV.
- D. Vapor Barrier Tape:

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1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.05 JACKETING AND ACCESSORIES

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 1. Lagging Adhesive:
 - a. Manufacturers:
 - 1) Design Polymerics; DP 3050 Water Based, Premium Quality, Lagging Adhesive, and Vapor Retarder: www.designpoly.com/#sle.
 - b. Compatible with insulation.
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket:
 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch sheet.
 3. Finish: Embossed.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- D. PVC Plastic.
 1. Manufacturers:
 - a. Johns Manville Corporation
 - b. Speedline Corporation
 - c. Knauf Insulation
 - d. Or Approved Equal
 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil.
 - e. Connections: Brush on welding adhesive.
 3. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

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- B. Insulate all supply diffusers and ducted return grilles with 2" R6 Duct Wrap. Cut diffusers so there is a folder 2" lap on all four sides. Tape with FSK tape where insulated flex meets duct insulation so there are no raw edges of fiberglass.
- C. Use of duct liner shall be limited to transfer ducts only.
- D. Install multiple layers of insulation with longitudinal and end seams staggered.
- E. Install insulation with least number of joints practical.
- F. The duct liner ends of all transfer ducts shall receive a channel nosing - 1" x liner thickness x 1", mechanically secured to the sheet metal duct in accordance with NAIMA fabrication standards.
- G. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
 - 5. 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.
- H. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- I. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

3.03 SCHEDULES

- A. All supply, outside air, and return air ductwork shall be completely insulated, unless otherwise noted on the plans. Insulation shall completely cover flexible connections. Insulation shall be minimum 2.5 inch thick or the thickness required to meet the R-values below.
- B. All insulation within the building envelope, except in the attic (where applicable), shall have a minimum R-value of 6.0 based on installed thickness. Any insulation wrap or board installed outside the building envelope or in an attic, shall have a minimum R-value of 8.0 based on installed thickness.
- C. All exhaust duct associated with any unit having energy recovery (enthalpy wheel, enthalpy plate, run around loop, etc.) shall be insulated to R6.0 inside the building and R8.0 outside the building.
- D. Exhaust and Relief Ducts Within 10 ft of Exterior Openings or Building Envelope Penetrations: minimum R-value of 6.0 based on installed thickness.

END OF SECTION 23 07 13

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SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Equipment insulation.
- B. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).
- D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2026.
- F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- H. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.
- I. ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks; 2025.
- J. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- M. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

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- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K Value: 0.36 at 75 degrees F.
 - 2. Maximum Service Temperature: 1,000 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Insulation: ASTM C1393; pipe and tank, end grain adhered to jacket.
 - 1. K Value: 0.27 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 2. Secure with outward clinch expanding staples and vapor barrier mastic.

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- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 - 1. K Value: 0.25 at 75 degrees F.
 - 2. Maximum Service Temperature: 1,200 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 - 4. Maximum Density: 8.0 pcf.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 HYDROUS CALCIUM SILICATE

- A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
 - 1. K Value: 0.40 at 300 degrees F.
 - 2. Maximum Service Temperature: 1,200 degrees F.
 - 3. Density: 15 pcf.
- B. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.
- C. Insulating Cement: ASTM C449.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Aeroflex USA; AEROFLEX EPDM Sheet/Roll: www.aeroflexusa.com/#sle.
 - 2. Armacell LLC; AP ArmaFlex: www.armacell.us/#sle.
 - 3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

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2.06 JACKETING AND ACCESSORIES

- A. PVC Plastic:
 - 1. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil, 0.030 inch.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 - 1. Lagging Adhesive: Compatible with insulation.
- C. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch sheet.
 - 3. Finish: Embossed.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- D. Reinforced Tape:
 - 1. FSK tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723 or ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - 4. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

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- F. Insulated equipment containing fluids below ambient temperature; insulate entire system.
- G. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- H. Inserts and Shields:
 - 1. Shields: Galvanized steel between hangers and inserts.
 - 2. Insert Location: Between support shield and equipment and under the finish jacket.
 - 3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Finish insulation at supports, protrusions, and interruptions.
- J. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting or PVC jacket and fitting covers.
- K. Exterior Applications:
 - 1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
 - 2. Cover with aluminum.
- L. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

- A. Cooling Systems: 1-1/2 inch elastomeric foam insulation. For exterior applications, 2 inch insulation.
 - 1. Chiller Cold Surfaces (Not Factory Insulated)
 - 2. Equipment Exposed to Freezing with Heat Tracing

END OF SECTION 23 07 16

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SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jacketing and accessories.
- D. Engineered wall outlet seals and refrigerant piping insulation protection.
- E. Section 07 84 00 - Firestopping.

1.02 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).
- E. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2026.
- G. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2025.
- H. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation; 2024.
- K. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- L. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- M. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- N. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2025.
- O. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).

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- P. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics; 2017 (Reapproved 2023).
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- R. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- S. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2026.
- T. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- U. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- V. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- W. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- X. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- Y. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

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PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Blanket: 1.0 pcf density.
 - 3. Weave: 5 by 5.
- H. Insulating Cement: ASTM C449.

2.03 CELLULAR GLASS

- A. Block Insulation: ASTM C552, Type I, Grade 6.
 - 1. K Value: 0.35 at 100 degrees F.
 - 2. Service Temperature: 800 degrees F, maximum.
 - 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.

2.04 HYDROUS CALCIUM SILICATE

- A. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
 - 1. K Value: 0.40 at 300 degrees F.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Density: 15 pcf.
- B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- C. Insulating Cement: ASTM C449.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:

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1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
 2. Armacell LLC: www.armacell.us/#sle.
 3. K-Flex USA LLC: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.06 RIGID, CELLULAR PHENOLIC

- A. Manufacturers:
1. Dyplast Products, LLC: www.dyplastproducts.com/#sle.
 2. ITW Insulation Systems: www.itwinsulation.com/#sle.
 3. Polyguard Products: www.polyguardproducts.com.com/#sle.
- B. Insulation: ASTM C1126, Type III, Grade 1.
1. Nominal Density: 3.75 pcf.
 2. Preliminary Initial Minimum K Value: 0.145 at 50 degrees F based on density of 2.5 pcf.
 3. Maximum Service Temperature: 248 degrees F.
 4. Minimum Service Temperature: Minus 292 degrees F.
 5. Minimum compressive strength as determined by ASTM D1621.
 6. Minimum tensile strength as determined by ASTM D1623.

2.07 JACKETING AND ACCESSORIES

- A. PVC Plastic.
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
 2. Covering Adhesive Mastic: Compatible with insulation.
 3. Color: Jacketing shall be color coded per the following:

Chilled Water Supply/Return	Medium Blue
Hot Water Supply/Return	Medium Red
Makeup Water	Green
Refrigerant	Gray

- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
1. Lagging Adhesive: Compatible with insulation.
- C. Aluminum Jacket:

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1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch sheet.
 3. Type: Factory-applied, self-adhesive jacketing.
 4. Finish: Embossed.
 5. Joining: Longitudinal slip joints and 2 inch laps.
 6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 7. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- D. Reinforced Tape:
1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 2. Comply with UL 723, ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 4. Finish: Match insulation.
- 2.08 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION
- A. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high.
 - a. Elastomeric Sleeve Diameter: 1-11/16 inch.
 2. Outlet Cover Color: Gray.
 3. Water Penetration: Comply with ASTM E331.
 4. Air Leakage: Comply with ASTM E283/E283M.
 5. Air Permeance: Comply with ASTM E2178.
- B. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
 3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
 4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
 5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.
 6. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.
- 2.09 ACCESSORIES
- A. General Requirements:
1. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
 2. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 3. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
1. Corrosion Control Gel:
 - a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

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PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Where existing piping insulation is either removed or damaged during construction, it shall be reinsulated per these specifications.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Where insulation thickness exceeds 3 inches, the insulation shall be two layers. Secure first layer before installing the next layer and stagger the joints.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. 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.
- G. Install insulation with least number of joints practical.
- H. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Insulation on all pipes or ducts conveying air or liquids below the ambient temperature is required to have a continuous vapor barrier. On all insulation with a vapor barrier, seal the joints, duct wrap seams, vapor retarder (ASJ) film seams and penetrations in insulation at hangers, supports, anchors, and other projections with a vapor-barrier coating/mastic as specified in the individual insulation sections.
 - 3. 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 coating/mastic.
 - 4. 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.
 - 5. 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. For hot piping conveying fluids over 120 degrees F, insulate flanges and unions at equipment.
- J. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.

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2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- K. Inserts and Shields:
 1. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 2. Insert location: Between support shield and piping and under the finish jacket.
 3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.
- M. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- N. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.
- O. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- P. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- Q. All exposed piping surfaces, insulation, supports, etc., shall be painted with two coats of oil base paint. Color shall be selected by the Owner.
- R. Insulation systems shall be installed per the applicable plate from the MICA manual 8th edition:
 1. Pre-formed Pipe Insulation Single Layer Construction: Plate 1-100
 2. Flexible Foam Insulation: Plate 1-200
 3. Field applied Metal Jacketing: Plate 1-400
 4. Non-metallic sealed jacketing systems: PVC, etc: Plate 1-510
 5. Split Ring Hangers: Plate 1-600
 6. Clevis Hanger with High Density Inserts: Plate 1-610
 7. Pre-Insulated Pipe Support, Standoff Clamp: Plate 1-640
 8. Vapor Stop (Dam) - Pipe: Plate 1-660
 9. Refrigerant and Low Temperature: Plate 1-801
 10. Traced Piping: Plate 1-900
 11. Pre-formed Elbow Insulation: Plate 2-100
 12. Mechanical Fitting Field Fabricated: Plate 2-116
 13. Pre-formed or Fabricated Tee Insulation: Plate 2-120
 14. Field or Factory-Fabricated Valve Insulation: Plate 2-130
 15. In-line Flange Insulation Built-up and Beveled: Plate 2-135

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16. Flexible Foam Fittings: 90s and 45s: Plate 2-200
17. Flexible Foam Fittings, Ts: 2-220
18. Flexible Foam Ts: Plate 2-225
19. PVC/Insert Valve Insulation: Plate 2-530
20. PVC/Insert Mechanical Coupling on In-line Flange: Plate 2-535
21. Non-metallic Jackets: Fitting and Valve Insulation Sealed Jacketing Systems: Plate 2-536
22. PVC End Cap Over Insulation: 2-540
23. Vapor Stop (Dam) - Fittings: Plate 2-660
24. Large Diameter Vessels Block and Blanket Insulation: Plate 4-100
25. Small Diameter Vessels: Plate 4-120
26. Large Diameter Horizontal Vessels: Plate 4-140
27. Vessels, Flexible Foam Sheets: 4-200
28. Flexible Foam for Low Temperature Equipment: 4-210
29. Vapor Stop (Dam) - Equipment: 4-660

3.03 SCHEDULE

A. Condensate

1. Condensate lines shall be insulated with 1.0 inch thick closed cell insulation. The insulation shall extend from the connection on the unit until it either terminates at a floor drain or other indirect waste receptor, or turns underground.

B. Refrigerant

1. Refrigerant lines shall be insulated with 1.5 inch thick closed cell elastomeric foam insulation. Both gas and liquid lines should be insulated.

END OF SECTION 23 07 19

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SECTION 23 08 00 - MECHANICAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Commissioning: Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper functional performance of equipment and systems.
 - 3. Verify that O&M documentation left on site is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained.

1.02 RELATED WORK

- A. Section 011000 – Summary of Work
- B. Section 013300 – Submittal Procedures
- C. Section 017700 – Closeout Procedures
- D. Section 017823 – Operation and Maintenance Data
- E. Section 017839 – Project Record Documents
- F. Section 017900 – Demonstration and Training
- G. Section 019113 – General Commissioning Requirements
- H. Section 250800 – Integrated Automation Commissioning

1.03 ABBREVIATIONS AND DEFINITIONS

- A. A/E: Architect, Architect/Engineer, Engineer and/or Design-Builder
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- E. CxA: Commissioning Authority
- F. CC: Controls Contractor
- G. CM: Construction Manager
- H. Cx: Commissioning
- I. Cx Plan: Commissioning Plan
- J. Cx RFI: Commissioning Request for Information

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- K. DDC: Direct Digital Control System
- L. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- M. EC: Electrical Contractor
- N. FBO: Furnished By Others
- O. FT: Functional Performance Test
- P. IAW: In Accordance With
- Q. MC: Mechanical Contractor
- R. O&M: Operation and Maintenance
- S. OPM: Owner Project Manager
- T. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- U. PC: Prefunctional Checklist
- V. RFI: Request for Information
- W. Sub(s): Subcontractors or Prime Contractor
- X. TAB: Test, Adjust and Balance
- Y. TBD: To Be Determined

1.04 MECHANICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. Mechanical Systems
 - 1. Building automation systems, including linkages to remote monitoring and control sites and water pumps, piping, and associated equipment.
 - 2. Air Handling Units (WSHP, AHU, etc.)
 - 3. Supply and Exhaust and other specialty fans
 - 4. DSC systems and Unit Heaters
 - 5. Ductwork
 - 6. Test, Adjust, and Balance of HVAC air and water systems
- B. Building Automation Systems (BAS)
 - 1. The entire BAS shall be subject to commissioning, including all hardware components, software, networking, programming and engineering services, and controls documentation.
 - 2. Any systems connected to the BAS (monitoring or otherwise) are subject to be commissioned.

1.05 SUBMITTALS

- A. Refer also to Specification Section 019113, Subsection 1.6.
- B. Provide the CxA a copy of the following items, for the systems to be commissioned:
 - 1. Equipment and System Submittals to include, at minimum, the following:
 - a. Equipment Data Sheets
 - b. Performance data
 - c. Manufacturer's pre-startup checklists

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- d. Manufacturer's start-up checklists
- e. Installation Instructions
2. Test, Adjust, and Balance (TAB) Reports
 - a. Planning Report - TAB contractor shall submit one copy of planning report (execution plan) to the CxA for review prior to beginning TAB work. At a minimum this report should include:
 - 1) Certifications on all instruments to be used throughout the testing. Certification must be documented within the previous 6 months.
 - 2) Résumés and Certification of individuals who will be balancing the systems.
 - 3) Detailed step-by-step plans for each procedure to be performed by the TAB Contractor.
 - 4) Sample forms to be used for each measurement.
 - b. Initial Test Report – Prior to starting final Balance Phase, submit a copy of the initial test report (TAB punchlist) to the CxA to indicate problem areas to be resolved before final balance is completed.
 - c. Final Report – Submit one copy of final test report to the CxA within 7 days after fieldwork is complete.
3. Shop drawings (including any resubmittals required by the A/E)
4. Ductwork - Supply one copy of the duct leakage test results for each test section
5. Piping - Supply one copy of all of hydrostatic pressure test results
6. Initial Pre-startup and start-up plan
7. Startup Testing Report
 - a. Prepare startup testing report on a per system basis, documenting the results of executed testing plan.
 - b. Copies of all completed test forms and checklists shall be provided
 - c. List of all outstanding deficiencies and uncompleted items
8. Operational and maintenance documentation
9. Training plan and training materials
10. As-Built documentation

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Specification Section 01 9113, Subsection 2.1.

2.02 CX WEB-BASED COMMISSIONING TOOL

- A. Refer to Specification Section 019113, Subsection 2.1.

PART 3 EXECUTION

3.01 MEETINGS

- A. Refer to Specification Section 019113, Subsection 3.3.

3.02 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.4 above.

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- B. General: Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan
 - 1. The CxA will provide prefunctional checklists (PFCs). PFCs indicate the required procedures to be executed as part of startup and initial checkout of the systems. An example of a standard AHU PFC is provided in Attachment 'A.'
 - 2. The subcontractor responsible for providing and installing the equipment develops the full start-up plan by combining (or adding to) the CxA's prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - 3. The full start-up plan shall consist of:
 - a. The CxA's prefunctional checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
 - c. The manufacturer's normally used field checkout sheets
 - d. Specifically, the mechanical start-up plan shall also include the contractors TAB plan.
 - 4. The contractor submits the full startup plan to the CxA for review and approval.
 - 5. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.
- D. Execution of Prefunctional Checklists and Startup
 - 1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the OPM, CM and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
 - 2. The CxA and possibly the A/E will observe the procedures for selected pieces of primary equipment.
 - 3. The CxA will observe the physical start-up of all major systems.
 - 4. The CxA will witness piping cleanout procedures and verify any required water or lab tests.
 - 5. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA will observe a sampling of the prefunctional and start-up procedures.
 - 6. The Subs and vendors shall execute startup and provide the CM with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CM reviews for completion and accuracy, then submits to the CxA.
 - 7. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
 - 8. Completed startup test report must be provided to CxA prior to functional testing.

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- E. Deficiencies, Non-Conformance and Approval in Checklists and Startup
 - 1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
 - 2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected.
 - 3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party. Refer to Section 019113, 3.3 – Documentation, Non-Conformance and Approval of Tests.

3.03 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to functional testing and demonstration for equipment and system in this division.
- B. The general list of equipment and systems to be commissioned is found in section 1.4.
- C. Objectives and Scope
 - 1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
 - 2. In general, each system shall be operated through all modes of operation where there is a specified system response.
 - 3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting, individual systems has been achieved, the interface or coordinated responses between systems is checked.
 - 4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.
- D. Development of Test Procedures
 - 1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, OPM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection.
- E. Coordination and Scheduling

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1. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Further, mechanical system functional testing shall not be scheduled until the final TAB report is approved and all reported deficiencies by TAB firm are corrected. Scheduling of functional testing shall be done with a minimum of two weeks notice prior to testing. Functional testing of the equipment and systems listed in section 1.4 of this specification section shall not be conducted out of the presence of the CxA and OPM, unless specifically approved to do so in writing by the CxA or OPM. Any functional testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout setpoint to be 2°F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.

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7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
 - G. Demonstration, Verification and Validation
 1. TAB Validation
 - a. The air balancing and water balancing is de-bugged, completed and approved before the CxA completes a TAB validation of air-related and water-related equipment or systems. The CxA will direct a TAB checkout by verifying the values reported in the final TAB report. The contractor shall supply all personnel and equipment for the checkout, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. The TAB verification shall verify:
 - 1) grilles, diffusers, and registers
 - 2) terminal devices
 - 3) all main HVAC systems, including energy recovery systems
 - 4) general exhaust fans
 - 5) kitchen hood exhaust
 - 6) fume hoods – as applicable
 - 7) hydronic systems (e.g. HW/CHW) equipment and distribution components
 2. Metering System
 - a. Demonstrate meters are calibrated in accordance with the manufacturer's published data approved.
 - b. Demonstrate accuracy of all meters.
 - c. Demonstrate utility monitoring integration with BAS.
 - H. Problem Solving
 1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.
- 3.04 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS
- A. Refer to Specification Section 019113, Subsection 3.7.
- 3.05 OPERATION AND MAINTENANCE MANUALS
- A. In addition to Installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing. O&M Manuals shall be in electronic form, the file format shall be Adobe Acrobat readable document. The document shall be formatted to include level 1 bookmarks that link to each main section of equipment. Refer to specification section 019113, subsection 3.8 for further detail.
- B. Refer to specification section 019113, Subsection 3.8 for further details.
- 3.06 TRAINING OF OWNER PERSONNEL
- A. See Specification Section 019113, Subsection 3.9.

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- B. CxA shall document the completion of comprehensive Owner training. Training shall include the understanding of the systems and the operation and maintenance of each major piece of HVAC equipment or system.
- C. Training shall include classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including AHUs, pumps, VAV terminals, VFDs, etc.

3.07 DEFERRED TESTING

- A. See Specification Section 019113, Subsection 3.10.

END OF SECTION 23 08 00

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SECTION 23 09 34 - VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.
- B. Overcurrent protective devices for motor controllers, including overload relays.
- C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 05 73 - Power System Studies: Additional criteria for selection and adjustment of equipment and associated protective devices specified in this section.

1.02 REFERENCE STANDARDS

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- D. NEMA IS 10033 - Industrial Control and Systems: Adjustable-Speed Drives; 2026.
- E. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems; 2022 (Reapproved 2025).
- F. NEMA IS 10035 - Application Guide for AC Adjustable Speed Drive Systems; 2021 (Reaffirmed 2025).
- G. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2023.
- H. NEMA MG 00001 - Motors and Generators; 2024.
- I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- L. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- M. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2); Current Edition, Including All Revisions.

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1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
 - 2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
 - 3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of controllers and adjacent equipment with required clearances indicated.
 - 2. Include wiring diagrams showing factory and field connections.
- D. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
- E. Maintenance Materials: Furnish following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Air Filters: Two of each different type.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

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- B. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.abb.com/#sle.
- B. Danfoss: www.danfoss.com/#sle.
- C. Honeywell
- D. Schneider.
- E. Siemens.
- F. Yaskawa.
- G. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Variable-Frequency Motor Controller:
 - 1. Configuration: Packaged controller with across-the-line bypass.
 - 2. Power Conversion System: Diode-based, 6-pulse type.
 - 3. Control Method: Vector; open-loop, without feedback.
 - 4. Filtering: Provide input/line reactor and output/load reactor.
- D. Controller Assemblies: Comply with NEMA IS 10033, NEMA IS 10034, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.
- E. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA IS 10035, NEMA MG 00001 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
 - 1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 00001 design letter or inverter duty rating for induction motors.
 - 2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
 - 3. Motor nameplate data.
 - 4. Requirements for speed control range, speed regulation, and braking.
 - 5. Motor suitability for bypass starting method, where applicable.
- F. Single Controllers Serving Multiple Motors:
 - 1. Control Method: Scalar/volts per hertz; do not use vector control method.

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2. Provide separate overload relay for each motor; provide auxiliary contacts and control wiring as required to shut down controller upon trip of any single overload relay.
3. Consider combined length of motor leads for cable length limits.
- G. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- H. Operating Requirements:
 1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
 2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
 3. Efficiency: Minimum of 96 percent at full speed and load.
 4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
 5. Overload Rating:
 - a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
 - b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.
- I. Power Conversion System: Microprocessor-based, pulse width modulation type.
 1. Diode-based, 6-pulse type unless otherwise indicated.
- J. Control System:
 1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
 2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
 3. Control Functions:
 - a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
 - 1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
 - 2) Vector Control: Provide selectable autotuning function.
 - b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
 - c. Selectable braking control; DC injection or flux braking.
 - d. Adjustable minimum/maximum speed limits.
 - e. Adjustable pulse width modulation switching carrier frequency.
 - f. Adjustable motor slip compensation.
 - g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
 4. Status Indications:
 - a. Motor run/stop status.
 - b. Motor forward/reverse status.
 - c. Local/remote control status.
 - d. Output voltage.
 - e. Output current.
 - f. Output frequency.
 - g. DC bus voltage.
 - h. Motor speed.

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5. Protective Functions/Alarm Indications:
 - a. Overcurrent.
 - b. Motor overload.
 - c. Undervoltage.
 - d. Overvoltage.
 - e. Controller overtemperature.
 - f. Input/output phase loss.
 - g. Output short circuit protection.
 - h. Output ground fault protection.
6. Inputs:
 - a. Digital Input(s): Three.
 - b. Analog Input(s): Two.
7. Outputs:
 - a. Analog Output(s): One.
 - b. Relay Output(s): Two.
8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
9. Features:
 - a. Password-protected security access.
 - b. Event log.
- K. Power Conditioning/Filtering:
 1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
 2. Reactor Impedance: 3 percent, unless otherwise indicated or required.
- L. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
 1. Disconnects: Circuit breaker or disconnect switch type.
 - a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
 - b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
 - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
 2. Provide door-mounted remote operator interface.
- M. Service Conditions:
 1. Provide controllers and associated components suitable for operation under following service conditions without derating:
 - a. Altitude: Less than 3,300 feet.
 - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.
- N. Short Circuit Current Rating:
 1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as determined by short circuit study performed in accordance with Section 26 05 73.
 2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.

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- O. Conductor Terminations: Suitable for use with conductors to be installed.
- P. Enclosures:
 - 1. Comply with NEMA IA 10030.
 - 2. NEMA EN 10250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.
 - 4. Cooling: Forced air or natural convection as determined by manufacturer.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers:
 - 1. Motor Circuit Protectors:
 - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of listed combination motor controller with overload protection; ratings, configurations, and features as indicated or as required.
 - b. Provide field-adjustable magnetic instantaneous trip setting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of controllers are consistent with indicated requirements.
- C. Verify that mounting surfaces are ready to accept controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install in accordance with NEMA IS 10034 and manufacturer's instructions.
- C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 23 05 29.
- F. Install controllers plumb and level.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Install field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

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- J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1. Tests listed as optional are not required.
- D. Correct deficiencies and replace damaged or defective controllers or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.07 PROTECTION

- A. Protect installed controllers from subsequent construction operations.

END OF SECTION 23 09 34

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SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Filter-driers.
- H. Flexible connections.
- I. Engineered wall seals and insulation protection.

1.02 REFERENCE STANDARDS

- A. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.
- B. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.
- E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- F. ASME B31.9 - Building Services Piping; 2025.
- G. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- H. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- I. IAPMO (UMC) - 2024 Uniform Mechanical Code; 2024.
- J. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- L. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

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1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- D. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- C. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.02 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Mechanical Press Fittings: UL 207 listed, ICC (IMC) and IAPMO (UMC) approved, with HNBR seals.
- B. Pipe Supports and Anchors:
 - 1. Provide hangers and supports complying with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 5. Vertical Support: Steel riser clamp.
 - 6. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

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9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.03 REFRIGERANT

- A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) no greater than that allowed by federal code.

2.04 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.05 VALVES

- A. Diaphragm Packless Valves:
 1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- B. Packed Angle Valves:
 1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Ball Valves:
 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
- D. Service Valves:
 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

2.06 STRAINERS

- A. Straight Line or Angle Line Type:
 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.07 CHECK VALVES

- A. Globe Type:
 1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

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2.08 FILTER-DRIERS

- A. Performance:
 - 1. Flow Capacity - Liquid Line: ____ ton, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
 - 2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
 - 3. Design Working Pressure: 350 psi, minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
 - 1. Connections: As specified for applicable pipe type.

2.09 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

2.10 ENGINEERED WALL SEALS AND INSULATION PROTECTION

- A. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
 - 1. Outlet Cover Color: Gray.
- B. Insulation Protection System: Mechanical line insulation and PVC cover.
 - 1. PVC Insulation Cover Color: Black with full-length velcro fastener.
 - 2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

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3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- F. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.5.
 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Flood piping system with nitrogen when brazing.
- I. Insulate piping and equipment.
- J. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- K. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- L. Fully charge completed system with refrigerant after testing.
- M. Provide electrical connection to solenoid valves. See Section 26 05 83.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Test refrigeration system in accordance with ASME B31.5.
- C. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.
- D. Refrigerant piping leak testing shall be as follows, unless equipment manufacturer mandates or recommends or more stringent procedure:
1. Connect the refrigerant manifold gauge hoses to the liquid side and gas side service ports on the equipment and connect the center hose to a nitrogen tank fitted with a pressure regulator.
 2. Fill the lines with nitrogen to 590 psi but no more than 595 psi.
 3. Monitor the pressure periodically for a minimum of 24 hours. If the pressure drops, use soapy water to check for leaks. Bubbles will occur if joints are not tight.
 4. Repair leaks. Repeat the previous steps until the pressure remains constant for 24 hours.
 5. Maintain 145 psi of pressure for 15 minutes and check for further leakage. If the pressure drops, check for leaks and repair. Repeat this step until 145 psi of pressure is maintained for 15 minutes.
 6. Remove hoses from service ports.
- E. Evacuation Procedure. After performing leak test, use a vacuum pump to triple evacuate the system as described below:

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1. Use a vacuum pump with a check valve to prevent pump oil from flowing backward while the vacuum pump is closed. Completely close the liquid-vapor line service valves of the outdoor unit.
2. Using vacuum-rated hoses, connect the manifold gauges to the liquid and suction (and high pressure, if applicable) gas pipes.
3. Evacuate the system to 750 microns, hold for 5 minutes, and check for leaks. Repair and repeat as necessary until vacuum holds.
4. Break the vacuum by applying 10 psi of nitrogen.
5. Evacuate the system to 500 microns, hold for 5 minutes, and check for leaks. Repair and repeat as necessary until vacuum holds.
6. Break the vacuum by applying 10 psi of nitrogen.
7. Evacuate the system to 200 microns. Wait for 15 minutes. A rise of no more than 200 microns is acceptable. If over 400 microns, check for leaks, repair, and repeat.
8. If under 400 microns, continue holding vacuum for 2.5 hours. If vacuum exceeds 400 microns at end of period, check for leaks, repair, and repeat.
9. If system holds under 400 microns for 2.5 hours, system is ready for charging.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

END OF SECTION 23 23 00

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SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Section 23 33 19 - Duct Silencers.

1.02 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- I. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration for 1/2" pressure class and higher systems.
 - 1. Clearly identify which fittings shall be used on the project: elbows, wyes, takeoffs, transitions, offsets, etc.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

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1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Galvanizing thickness and country of origin must be clearly stenciled on each duct section. At the discretion of the Engineer, sheet metal gauges and reinforcing may be randomly checked to verify all duct construction is in compliance.
- C. Ductwork and fittings must have a computer generated label affixed to each section detailing the duct dimensions, sheet metal gauge, intermediate and joint reinforcement size, and the transverse connector brand and classification.

1.05 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.
- C. If ductwork is stored on site, elevate duct above floors and maintain protection on ends.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 33 19.
- C. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
 - a. Low Pressure Supply Air: 2 in-wc pressure class, galvanized steel.
 - b. Outside Air Intake: -2 in-wc pressure class, galvanized steel.
 - c. Return and Relief Air: 2 in-wc pressure class, galvanized steel.
 - d. General Exhaust Air: -2 in-wc pressure class, galvanized steel.
 - 2. Low Pressure Service: Up to 2 in-wc:
 - a. Seal: Class C, apply to seal off transverse joints.
 - b. Leakage:
 - 1) Rectangular: Class 24 or 24 cfm/100 sq ft.
 - 2) Round: Class 12 or 12 cfm/100 sq ft.
- D. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - a. Internal tie rods or bracing are not allowed for ductwork 36" and below. Tie rods shall be 1/2", 3/4", 1", 1-1/4" or 1-1/2" galvanized rods with bolt assembly consisting of rubber washer and friction anchored threaded insert similar to Ductmate Easyrod or PPI Condu-Lock.

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- b. Internal tie rods are not allowed for ductwork in chase and other non-accessible locations.
2. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
3. Where the size for a duct segment is not indicated, the duct segment size shall be equal to the largest duct segment to which it is connected. Transition to smaller size shall occur on the side of the fitting where smaller size is indicated.
4. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
5. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
6. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
2. Stainless Steel: ASTM A666, Type 304.
3. "Paint Grip" Finish or Mill Phosphatized Steel (Exposed Ductwork):
 - a. Galvanized G90 steel shall be put through a phosphate bath and have a layer of Chromate applied and dried leaving it ready to accept paint. This shall be done at the mill. The process produces a dull gray colored finish.

B. Rectangular Metal Duct:

1. Rectangular Duct:
 - a. Unless otherwise indicated, use Pittsburgh lock seam construction.
 - b. Seal longitudinal seams with approved sealant or provide pre-sealed from factory with encapsulated mastic.
 - c. Button punch snap lock construction (SMACNA L-2) is not allowed except for ductwork that is both low pressure (2" WG or lower pressure class) and 18" and smaller duct width.
 - d. Button punch snap lock construction is not allowed for ductwork in chases and areas above inaccessible ceilings.
 - e. Button punch snaplock construction is not allowed on exhaust ductwork or aluminum ductwork
2. Transverse Joint Connectors:
 - a. Slide-on Transverse Joint Connectors:
 - 1) Duct constructed using engineered slide-on connector systems must be submitted and conform to manufacturer's published duct construction standards and guidelines for joint classification, sheet metal gauge, intermediate and joint reinforcement size and spacing, unless otherwise specified.

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- 2) Manufacturer of engineered connector system must have certified independent performance testing for leakage, deflection and seismic stability.
 - 3) All components of the engineered system must be clearly embossed with the manufacturer's name, model number or identifying marking.
 - 4) Butyl rubber gasket must be applied per the manufacturer's instructions on all connections except for breakaway connections. Closed Cell Neoprene gasket must be applied per the manufacturer's instructions on all breakaway connections. No substitution of connector system components or gaskets is permitted.
 - 5) All duct installed using engineered connectors must adhere to the manufacturer's published assembly and installation guidelines for all standard, breakaway, roof-top or specialty connections unless otherwise specified.
- b. Formed-on Flanges:
- 1) Lockformers TDC or Engles TDF may be used in accordance with T-25 flanges of SMACNA HVAC Duct Construction Standards, provided that corner pieces with bolts are used. If TDF/TDC flanges are damaged, replace the damaged joint(s) by straightening and reinforcing with minimum 1-1/2 x 1-1/2 x 1/4 angle at each side of transverse joint
- C. Round Metal Ducts:
1. Unless otherwise indicated, longitudinal seams shall be in accordance with SMACNA HVAC Duct Construction Standards with the following exceptions:
 - a. Snaplock seams are not allowed.
 - b. SMACNA seam types RL-3, 6A, 6B, 7, and 8 shown in Figure 3-2 are not allowed, except for 2" w.g. class round ducts 16" or less in diameter.
 2. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
 3. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
 - a. Insulation:
 - 1) Thickness: 1 inch.
 - 2) Material: Air.
 4. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- D. Round Spiral Duct:
1. Round spiral lock seam duct with galvanized steel outer wall.
- E. Connectors, Fittings, Sealants, and Miscellaneous:
1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
 2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
 3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

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4. Gasket Tape:
 - a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
6. Cable Suspension System:
 - a. Suspension system shall be Gripple Hang-Fast as manufactured and supplied by Gripple, Inc., or Ductmate "Clutcher" cable hanging system.
 - b. Suspension system shall be load rated and verified by SMACNA Testing and Research Institute to be in compliance with SMACNA Standards.
 - c. All suspension systems shall used galvanized hardware.

2.03 FLEXIBLE DUCTS

- A. Flexible Air Ducts:
 1. UL 181, Class 0, interlocking spiral of aluminum foil.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: 8 in-wc positive or negative.
 4. Maximum Velocity: 5,000 fpm.
 5. Temperature Range: Minus 20 to 250 degrees F.
 6. Manufacturers:
 - a. Lindab.
 - b. Flexmaster.
 - c. Clevaflex.
 - d. Thermaflex.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Install ductwork parallel to building walls and ceilings and at such heights not to obstruct any portion of window, doorway, stairway, or passageway. Install ductwork to allow adequate access and service space for equipment and access clearances for cable tray/j-hooks. Refer to drawings and/or manufacturer's recommendations. Install vertical ductwork plumb. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Check plans showing work of other trades and consult with Engineer in event of any interference.

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- F. Where interferences develop in the field, offset or reroute ductwork as required to clear such interferences. Do not divide duct and do not route any other utilities such as piping or conduit through duct. In all cases, consult drawings for exact location of space allocated for duct, ceiling heights, door and window openings, or other architectural details before fabricating or installing duct. Consult Designer where conflicts arise between ductwork and other utilities which cannot be resolved by relocating duct.
- G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- H. Where offsets in ductwork are required, contractor to use standard 30, 45 or 90-degree elbows. Where space constraints do not allow for the use of standard elbows for offsets, use of angled offsets as depicted by SMACNA Figure 2-7 (Angled Offset Type 1) may be used with maximum angle of offset not to exceed 15 degrees maximum. Offsets Type 2 and 3 in SMACNA Figure 2-7 shall not be allowed.
- I. Rectangular Duct Elbows:
 - 1. Rectangular Duct: Unless specific type is indicated, provide radius elbows with splitter vanes with minimum centerline radius to width or diameter ratio of 1.5
 - a. 1.5 radius elbows with full splitter vanes as follows:
 - 1) One vane for duct width 2-12"
 - 2) Two vanes for duct width 13-20"
 - 3) Three vanes for duct width 21"-36"
 - 4) Four vanes for duct width 38" and larger
 - 5) Fabricate vanes in accordance with SMACNA.
 - b. Rectangular throat elbows with turning vanes where 1.5 radius elbows do not fit.
 - c. Rectangular throat/radius heel elbows or rectangular elbows without turning vanes shall not be used.
- J. Round and Oval Duct Elbows:
 - 1. Unless specific type is indicated, use radius elbows with centerline radius to diameter ratio of 1.5. ONLY where 1.5 radius elbows do not fit, 1.0 radius elbows may be used if approved by the Engineer.
- K. Construct ductwork so that interior surfaces are smooth. Internal duct hangers and internal bracing are not allowed. Refer to above for internal tie rods.
- L. Support coils, filters, air terminals, dampers, sound attenuating devices, or other devices installed in duct systems with angles or channels and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets, nuts, bolts and washers.
- M. Flexible ducts shall not exceed 5 feet in length. Bends, kinks, and sagging of flexible duct will not be accepted. The maximum permitted sag is 1/2" per foot of support spacing.
- N. Install outside air intake duct to pitch down at minimum 1" per 20 ft toward intake louver or plenum and to drain to outside of building. Solder or seal seams to form watertight joints.
- O. Install exhaust air duct to pitch down at minimum 1" per 20 ft toward exhaust louver.

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- P. Where 2 different metal ducts meet, install joint in such a manner that metal ducts do not contact each other by using proper gasket seal or compound.
- Q. Flexible Ducts: Connect to metal ducts with adhesive plus sheet metal screws.
 - 1. Flexible ducts are not allowed for special exhaust systems, such as laboratory exhaust, vehicle exhaust, etc.
 - 2. Splicing of flexible duct will not be allowed.
 - 3. Flexible ducts shall not pass through any partition, wall, floor, or ceiling.
- R. All ducts conveying hazardous or flammable vapors shall be labeled via stencilled painting or permanent nameplates. Labels shall be every 10 feet where above accessible ceilings or in mechanical rooms or on roof.
- S. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- T. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal cap with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- U. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- V. Use double nuts and lock washers on threaded rod supports.
- W. Connect terminal units to supply ducts with hard duct. Maintain minimum three (3) feet or three (3) duct diameters (whichever is greater) of straight duct prior to inlet of box. Connecting flex duct to the inlets of terminal units will NOT be acceptable.
- X. Provide minimum 5 ft of straight duct on outlet side of VAV boxes before first tap.
- Y. Connect diffusers or light troffer boots to low-pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- Z. Set plenum doors at 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- AA. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- BB. All exposed ductwork to be painted shall be mill bonderized or "paint grip." The contractor shall thoroughly clean all ductwork surfaces to be free from oils, grease, lubricants, and other contaminants prior to application of paint.
- CC. 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.
- DD. Louver Fit-out:
 - 1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
 - 2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.

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END OF SECTION 23 31 00

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Duct Air Turning Vanes
- D. Wire Mesh Screens
- E. Duct access doors.
- F. Duct test holes.
- G. Fire dampers.
- H. Flexible duct connectors.
- I. Volume control dampers.
- J. Miscellaneous Products:
 - 1. Internal strut end plugs.
 - 2. Duct opening closure film.
 - 3. Flexible Duct 90° Elbow Support

1.02 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.
- D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2027.
- E. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- G. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- H. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.

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- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.
- D. Project Record Drawings: Record actual locations of access doors and test holes.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Fusible Links: One of each type and size.

1.04 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com/#sle.
 - 2. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 3. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle.
 - 5. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 - 2. Nailor Industries, Inc: www.nailor.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. United Enertech: www.unitedenertech.com/#sle.
 - 5. Greenheck.
 - 6. Arrow.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
- C. Frames shall be flanged, a minimum of 3 inches wide, and a minimum of 20 gauge roll formed galvanized steel or 0.125 inch extruded aluminum with pre-punched mounting holes and welded corner clips for maximum rigidity.
- D. Blades shall be single piece, with a maximum width of 6 inches, counter balanced, and shall be constructed of minimum 26 gauge roll formed galvanized steel or 0.070 inch extruded aluminum. Blade ends shall overlap for maximum weather protection.
- E. Blade seals shall be extruded vinyl and mechanically attached to blade edge.

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- F. Bearings shall be corrosion resistant synthetic.
- G. Linkages shall use a galvanized tie bar with stainless steel pivot pins.
- H. Axles shall be stainless steel.
- I. Mounting shall be suitable for the required orientation.

2.03 DUCT AIR TURNING VANES

- A. Provide factory manufactured turning vanes in each elbow where inside radius is less than the width of the duct, and in all square or rectangular elbows.
- B. Turning vane assemblies shall be adequately supported and affixed to prevent rattling, breakaway, and shall not deform. Assemblies longer than 12 inches shall be double wall.
- C. Turning vanes in negative pressure ductwork with pressure rating above 2 inches shall be installed in accordance with SMACNA Industrial Duct Construction Standard.
- D. Turning vanes shall match the duct material construction.
- E. Rectangular Throat Elbow Turning Vanes (Vane Runner Length up to 18" and Vane Length up to 36")
 - 1. Provide single blade type vanes having 2" radius and 1-1/2" spacing, 24 gauge minimum. Construct vanes in accordance with SMACNA HVAC Duct Construction Standards.
 - 2. If duct size changes in mitered elbow, use single blade type vanes with trailing edge extension.
- F. Rectangular Throat Elbow Turning Vanes (Vane Runner Length up to 18" and Vane Length up to 36"):
 - 1. Use double wall airfoil type with smoothly-rounded entry nose and extended trailing edge on 2.4" center spacing.
 - 2. Vanes shall be equal to HEP (High Efficiency Profile) vanes as manufactured by Aero/Dyne Co.
- G. Radius Elbow Splitter Vanes:
 - 1. Splitter vanes for radius elbows shall be extended entire length of fitting and constructed in accordance with SMACNA HVAC Duct Construction Standards.
- H. Manufacturers:
 - 1. Aero Dyne
 - 2. Ductmate, Inc.
 - 3. Sheet Metal Connectors, Inc.
 - 4. Duro-Dyne
 - 5. DynAir Inc.

2.04 WIRE MESH SCREENS

- A. Screen assemblies shall be removable.
- B. Mesh: 1/2 inch square pattern, 1/16 inch galvanized wire, interwoven, welded at wire intersections and to the frame to prevent rattles.

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- C. Frames: Minimum of 1 inch by 1 inch by 1/8 inch galvanized steel angles for duct sizes through 24 inches, 1-1/2 inch by 1-1/2 inch by 3/16 inch for duct sizes between 25 inches and 48 inches, and 2 inches by 2 inches for ducts larger than 48 inches continuous around perimeter of screen. Provide intermediate supports to limit screen deflection to 1/16 inch at maximum design airflow.

2.05 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc, a Division of Nelson Industrial Inc: www.acudor.com/#sle.
 - 2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 3. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 4. Lloyd Industries, Inc: www.firedamper.com/#sle.
 - 5. Nailor Industries, Inc: www.nailor.com/#sle.
 - 6. Ruskin Company: www.ruskin.com/#sle.
 - 7. SEMCO LLC; _____: www.semcohvac.com/#sle.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum 1-inch thick insulation with sheet metal cover.
 - 1. Up to 18 inches Square: Provide two hinges and two sash locks.
 - 2. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
- C. Access doors with sheet metal screw fasteners are not acceptable.
- D. Provide optional auxiliary switch package to allow remote indication of damper blade position.
- E. Manufacturer shall provide a neoprene gasket around perimeter of access door for airtight seal.
- F. Systems 2" w.g. or less shall use a hinged, cam, or hinged & cam square framed access door.
- G. Systems 3" w.g. and above shall use a sandwich type access door. Construct doors in accordance with Figure 7-3 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible," Third Edition. Doors shall be rated for +/- 10" w.g.

2.06 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.07 FIRE DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 - 3. Pottorff: www.pottorff.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle.
 - 5. United Enertech: www.unitedenertech.com/#sle.
 - 6. Air Balance/ABI.

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7. Greenheck.
 8. Metal Industries.
 9. Prefco.
 10. ATI Industries.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Fire Resistance: 1-1/2 hours or 3 hours as required by assembly rating.
- D. Dynamic Closure Rating: Dampers shall be classified for dynamic closure to 4000 fpm and 4 inches w.g. static pressure.
- E. Construction:
- F. Integral Sleeve Frame: Minimum 20 gauge roll formed galvanized steel. Sleeve length to be determined by Contractor for each condition.
- G. Blades:
1. Curtain type
 2. Action: Spring or gravity closure upon fusible link release.
 3. Orientation: Horizontal.
 4. Material: Minimum 24 gage roll formed, galvanized steel.
- H. Closure Springs: Type 301 stainless steel, constant force type, if required.
- I. Mounting: Vertical and/or Horizontal.
- J. Duct Transition Connection, Damper Style:
1. B style – rectangular connection, blades out of air stream, high free area.
 2. G style – A style connection, grille mounting tabs at end of sleeve for grille.
 3. CR style – round connection, sealed.
- K. Finish: Mill galvanized.
- L. Fusible Links: UL 33, separate at 165 degrees F with adjustable link straps for combination fire/balancing dampers.
- M. Breakaway Connection: Ductmate or Drivemate.

2.08 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
1. Carlisle HVAC Products: www.carlislehvac.com/#sle.
 2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 3. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 4. Durodyne.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
- D. Flexible duct connector shall be used where ductwork connects to fan apparatus or fan casings to isolate vibration transfer. Connectors shall be attached in such a manner as to provide an airtight and waterproof seal.
- E. Connectors will comply with NFPA 90A, "Installation of Air Conditioning & Ventilation Systems" and NFPA 90B, "Installation of Warm Air Heating & Air Conditioning Systems".

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- F. Connector fabrics shall meet NFPA 701 (formerly UL 214.)
- G. Connector fabrics shall be mildew resistant per ASTM G21.
- H. Indoor installations shall be NFPA 701 listed, fire retardant Vinyl coated woven nylon or Neoprene coated woven fiberglass fabric. Minimum density of Vinyl is 20 oz. /sq. yd. and rated to 200F. Minimum density of Neoprene 30 oz. / sq. yard and rated to 200F.
- I. Outdoor installations shall be NFPA 701 listed UV-resistant Hypalon coated woven fiberglass fabric. Minimum density 24 oz. /sq. yd. and rated to 250F.
- J. High temperature applications shall be NFPA 701 listed, Silicone coated satin weave fiberglass fabric. Minimum density 17.5 oz. /sq. yd. and rated to 500 F.
- K. Chemical resistant applications shall be of Teflon coated woven fiberglass fabric. Minimum density 18 oz. /sq. yd. and rated to 500 F.

2.09 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 2. Nailor Industries, Inc; _____: www.nailor.com/#sle.
 - 3. NCA, a brand of Metal Industries Inc; _____: www.ncamfg.com/#sle.
 - 4. Ruskin Company; _____: www.ruskin.com/#sle.
 - 5. United Enertech; _____: www.unitedenertech.com/#sle.
 - 6. Greenheck.
 - 7. Pottorff.
 - 8. Johnson Controls.
 - 9. Air Balance, Inc.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Round Damper - 1 in w.g. and below:
 - 1. Velocity: Up to 2,000 fpm
 - 2. Temperature: 180°F
 - 3. Construction:
 - a. Frame Material - Galvanized Steel
 - b. Frame Thickness: 20 gauge
 - c. Blade Material: Galvanized Steel
 - d. Axle Bearings: Bronze
 - e. Axle Material: Plated Steel
 - f. Operator: 3/8 inch sq. locking manual quadrant.
 - 1) On insulated ducts, provide 2 inch standoff bracket
- D. Round Damper - 4 in w.g. and below:
 - 1. Velocity: Up to 3,000 fpm
 - 2. Temperature: 180°F
 - 3. Leakage: 4 cfm/ft² @ 1 in. wg
 - 4. Construction:
 - a. Frame Material - Galvanized Steel
 - b. Frame Thickness: 20 gauge
 - c. Blade Material: Galvanized Steel
 - d. Blade seal: Silicone
 - e. Axle Bearings: Bronze

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- f. Axle Material: Plated Steel
 - g. Operator: 3/8 inch sq. locking manual quadrant.
 - 1) On insulated ducts, provide 2 inch standoff bracket
- E. Rectangular Single Blade Dampers: 1 in w.g. and below, up to 10 x 30 inch duct
 - 1. Velocity: Up to 2,000 fpm
 - 2. Temperature: 180°F
 - 3. Construction:
 - a. Frame Material - Galvanized Steel
 - b. Frame Thickness: 20 gauge
 - c. Blade Material: Galvanized Steel
 - d. Axle Bearings: Synthetic sleeve type
 - e. Axle Material: Plated Steel
 - f. Operator: 3/8 inch sq. locking manual quadrant.
 - 1) On insulated ducts, provide 2 inch standoff bracket
- F. Rectangular Multi-Blade Balancing Dampers: 2 in w.g. and below
 - 1. Pressure: Up to 4 in w.g.
 - 2. Velocity: Up to 2,000 fpm
 - 3. Temperature: 180°F
 - 4. Construction:
 - a. Frame Material - Galvanized Steel
 - b. Frame Thickness: 16 gauge
 - c. Blade Material: Galvanized Steel
 - d. Blade Thickness: 16 gauge
 - e. Blade Type: 3V
 - f. Blade Operation: Opposed
 - g. Axle Bearings: Synthetic sleeve type
 - h. Axle Material: Plated Steel
 - i. Operator: 1/2 inch sq. locking manual quadrant, 1-1/2 inch long standoff bracket
 - j. Extension Pin: 1/2 inch diagonal glass reinforced polymer extends 3-1/2 inch beyond frame.
- G. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.
 - 4. Provide handles capable of being locked.
 - 5. Provide colored handles or paint with red/orange paint.

2.10 MISCELLANEOUS PRODUCTS

- A. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.
- B. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
 - 1. Thickness: 2 mils.
 - 2. High tack water based adhesive.
 - 3. UV stable light blue color.

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4. Elongation Before Break: 325 percent, minimum.
- C. Flexible Duct 90° Elbow Support
 1. Manufacturers:
 - a. Build Right Products
 - b. Hart and Cooley
 - c. Thermaflex
 2. Pre-manufactured support to form any brand flexible duct into a smooth 90 degree elbow.
 - a. One size shall fit 4" to 16" flexible ducts.
 - b. No additional tools shall be required for installation.
 - c. UL listed for use in Return Air Plenums.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide a pre-manufactured support at each diffuser to turn the flex duct into a 90° elbow.
- D. Contractor shall identify balancing dampers above the ceiling by either spray painting them bright orange or hanging an orange flag from the damper handle. If hanging a flag in a return air plenum, material shall comply with fire and smoke spread ratings for plenum use.
- E. All fire dampers, smoke dampers, and combination fire/smoke dampers shall be installed with bottom edge 24" maximum above lay-in ceiling.
- F. All balancing dampers shall be installed maximum 30" above the lay-in ceiling.
- G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 12 by 12 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 8 by 8 inch size access door for balancing dampers only. Review locations prior to fabrication.
- H. Provide duct test holes where indicated and required for testing and balancing purposes.
- I. Provide fire dampers at locations indicated, where ducts and outlets pass through fire-rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- J. The Contractor shall inspect and test all fire dampers, smoke dampers, and combination fire/smoke dampers in accordance with NFPA 80 in the presence of the Authority Having Jurisdiction.

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- K. Demonstrate re-setting of fire dampers to Owner's representative.
- L. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- M. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
 - 1. See Section 23 05 48.
- N. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 23 33 00

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SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cabinet exhaust fans.
- B. Inline centrifugal fans and blowers.

1.02 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2025.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2025.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.
- B. Sequencing: Ensure that utility connections are completed in an orderly and expeditious manner.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set for each individual fan.

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1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

- A. Request Owner permission to use permanent ventilator(s) for ventilation during construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
- B. Greenheck Fan Corporation: www.greenheck.com/#sle.
- C. Loren Cook Company: www.lorencook.com/#sle.
- D. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.
- E. Twin City Fan & Blower: www.tcf.com/#sle.

2.02 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- F. Enclosed Safety Switches: Comply with NEMA EN 10250.

2.03 CABINET EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resiliently mounted motor, gravity backdraft damper in discharge.
- B. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor and wall mounted solid state speed controller or EC motor, refer to fan schedule..
- C. Grille: Aluminum with baked white enamel finish.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is reached with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- E. Performance Ratings: As indicated on drawings.

2.04 INLINE CENTRIFUGAL FANS AND BLOWERS

- A. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with acoustic insulation, resiliently-mounted motor, gravity backdraft damper in discharge.

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- B. Forward Curved Blower:
 - 1. Direct-driven, resiliently mounted motor, heavy-duty ball bearings, galvanized steel housing for indoor service, and removable service panels.
 - 2. Accessories: Provide backdraft damper.
- C. Disconnect Switch: Cord and plug-in housing for thermal overload protected motor with a solid state speed controller.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Hung Cabinet Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads, see Section 23 05 48.
 - 2. Install flexible connections between fan and ductwork; see Section 23 33 00. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.
- C. Provide sheaves required for final air balance.
- D. Install backdraft dampers on inlet to roof and wall exhausters.
- E. Provide backdraft dampers on outlet from cabinet and ceiling exhausters fans and as indicated.

END OF SECTION 23 34 23

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SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rectangular ceiling diffusers.
- B. Ceiling slot diffusers.
- C. Duct-mounted supply and return registers/louvers.
- D. Ceiling supply registers/grilles.
- E. Ceiling exhaust and return registers/grilles.
- F. Wall supply registers/grilles.
- G. Wall exhaust and return registers/grilles.
- H. Louvers.
- I. Diffusers:
- J. Registers/grilles:
 - 1. Perforated ceiling return grilles.
- K. Louvers:
 - 1. Horizontal blade.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
- B. Krueger-HVAC: www.krueger-hvac.com/#sle.
- C. Metalaire, a brand of Metal Industries Inc: www.metalaire.com/#sle.
- D. Price Industries: www.price-hvac.com/#sle.
- E. Ruskin Company: www.ruskin.com/#sle.
- F. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.
- G. Tuttle and Bailey: www.tuttleandbailey.com/#sle.
- H. Nailor.

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2.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.
- B. Connections: Round.
- C. Frame: Provide surface mount and inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Steel with baked enamel finish.
- E. Color: As selected by Architect from manufacturer's standard range.

2.03 PERFORATED FACE CEILING RETURN AND EXHAUST GRILLES

- A. Type: Perforated face with removable face.
- B. Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Steel with steel frame and baked enamel finish.
- D. Color: As selected by Architect from manufacturer's standard range.

2.04 CEILING SLOT DIFFUSERS

- A. Type: Continuous 1/2, 3/4, or 1-inch wide slot as scheduled, number of slots wide as scheduled, with adjustable vanes for left, right, or vertical discharge.
- B. Fabrication: Aluminum extrusions with factory baked enamel finish.
- C. Color: To be selected by Architect from manufacturer's standard range.
- D. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket, mitered end border.
- E. Plenum: Integral, galvanized steel, insulated.

2.05 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

- A. Type: Duct-mounted, rectangular register for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- B. Material: 22 gauge, 0.0299 inch.
 - 1. Provide crossing spiral fitting-body of matching duct diameter.
- C. Color: As selected by Architect from manufacturer's standard range.

2.06 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, double deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

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- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.07 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.08 LOUVERS

- A. Manufacturers:
 - 1. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 - 2. Ruskin Company: www.ruskin.com/#sle.
 - 3. Airolite.
 - 4. Arrow United Industries.
 - 5. Greenheck.
 - 6. IAC.
 - 7. Pottorff.
 - 8. Reliable.
 - 9. United Enertech.
- B. AMCA Listing Label Compliance:
 - 1. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.
- C. Fabrication Horizontal Balde:
 - 1. Design: Double drainable blades shall be contained within the frame with double downspouts in jambs and mullions. Louver design shall limit span between visible mullions to 120 inches.
 - 2. Frame:
 - a. Frame Depth: 2, 4, or 6 inches as scheduled.
 - b. Wall Thickness: 0.081 inch, nominal.
 - c. Material: Extruded aluminum.
 - 3. Blades:
 - a. Style: Sightproof, double drainable, horizontally mounted on 2 inches centers, nominal.
 - b. Material: Extruded aluminum.
 - c. Wall Thickness: 0.063 inch nominal.
 - 4. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.
- D. Performance Data:
 - 1. Based on testing 48 inch x 48 inch size unit in accordance with AMCA 500.
- E. Wind Driven Water Penetration Performance:

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1. Based on testing 39 inches x 39 inches core area, 41 inches x 44 inches nominal size unit in accordance with AMCA 500-L.
2. Wind Velocity: 29 mph
 - a. Rainfall Rate: 3 inches/hour.
 - b. Free Area Velocity: 2149 feet per minute.
 - c. Water Resistance Effectiveness: 99.9% (AMCA Class A).
3. Wind Velocity: 50 mph.
 - a. Rainfall Rate: 8 inches/hour.
 - b. Free Area Velocity: 2175 feet per minute.
 - c. Water Resistance Effectiveness: 99.8% (AMCA Class A).
4. Design Windload: Per Code. Refer to Structural Drawings and Code Summary Sheet.
 - a. Structural Performance: Provide products capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of components including blades, frames, and supports; noise or metal fatigue caused by component rattle or flutter; or permanent damage to fasteners and anchors.
 - b. Thermal Movements: Provide products 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, and other detrimental effects:
 - c. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
5. Louvers shall be factory engineered to withstand the specified seismic loads.
 - a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).
6. Accessories:
 - a. Blank-Off Panels: 0.040 inch aluminum sheet, factory installed with removable fasteners and neoprene gaskets.
 - b. Bird Screen:
 - 1) Aluminum: Aluminum, 1/2 inches by 0.063 inch, expanded and flattened.
 - 2) Frame: Removable.
 - c. Extended Sills:
 - 1) Extruded aluminum. Minimum nominal thickness 0.081 inch. Upturned side panels to prevent water leakage.
 - d. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.
 - e. Finishes:
 - f. Anodized Finishes:
 - 1) Class I Color Anodized.
 - (a) Comply with Aluminum Association AA-C21A44.
 - (b) Apply finish following chemical etching and pretreatment.
 - (c) Class I Color Anodized: Dark Bronze (Color to be confirmed during Shop Drawings).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

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- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

3.02 PROTECTION

- A. Protect installed products until completion of project.
- B. Replace, repair, or touch-up damaged products before Substantial Completion.

END OF SECTION 23 37 00

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SECTION 23 81 26.13 - SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Indoor air handling (fan and coil) units for ducted systems.
- D. Indoor air handling (fan and coil) units for ductless systems.
- E. Controls.
- F. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.02 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2026.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- E. NEMA MG 00001 - Motors and Generators; 2024.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.
- G. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2027.
- H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

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1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturers warranty for compressors

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.
 - 2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.
- C. Electrical Characteristics:
 - 1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 05 83.

2.02 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

- A. Manufacturers:
 - 1. Carrier Corporation: www.carrier.com/#sle.
 - 2. Trane Technologies, PLC: www.trane.com/#sle.
 - 3. York International Corporation / Johnson Controls: www.york.com/#sle.
 - 4. Mitsubishi Electric Corporation.
- B. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
 - 1. Air Flow Configuration: Upflow.
 - 2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- C. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
 - 1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
 - 2. Motor Electrical Characteristics:
- D. Air Filters: 1 inch thick glass fiber, disposable type arranged for easy replacement.
- E. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

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2. Manufacturers: System manufacturer.

2.03 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Manufacturers:
 1. Carrier.
 2. Daikin
 3. Fujitsu
 4. LG
 5. Mitsubishi
 6. Samsung
 7. Trane
 8. Or Approved Equal
- B. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- C. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 2. Manufacturer: System manufacturer.

2.04 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 1. Comply with AHRI 210/240.
 2. Refrigerant: R-454B or _____.
 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high-pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 1. Condenser Fans: Direct-drive propeller type.
 2. Airflow orientation: Horizontal. Front discharge, rear intake.
- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
 1. Provide thermostatic expansion valves.
 2. Provide heat pump reversing valves.
- F. Operating Controls:
 1. Control by room thermostat to maintain room temperature setting.

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2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

2.05 ACCESSORY EQUIPMENT

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 1. System selector switch (heat-off-cool) and fan control switch (auto-on).
 2. Automatic switching from heating to cooling.
 3. Preferential rate control to minimize overshoot and deviation from setpoint.
 4. Set-up for four separate temperatures per day.
 5. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 6. Short cycle protection.
 7. Programming based on weekdays, Saturday and Sunday.
 8. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
 9. Battery replacement without program loss.
 10. Thermostat Display:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with NFPA 90A and NFPA 90B.
- B. Install refrigeration systems in accordance with ASHRAE Std 15.
- C. Pipe drain from cooling coils to nearest floor drain or building exterior as shown on the Drawings.

3.03 OWNER TRAINING

- A. Location: Job site
- B. An authorized manufacturer's representative shall conduct the training session.

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C. Provide minimum four (4) hours training for six (6) people.

D. Provide video recording of the training session. Turn over video to Owner at the conclusion of the project

END OF SECTION 23 81 26.13

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SECTION 23 82 00 - CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fan-coil units.
- B. Electric unit heaters.
- C. Electric cabinet unit heaters.
- D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.02 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- C. AHRI 440 - Performance Rating of Room Fan-Coils; 2008.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
 - 4. Submit the following for blower-coil units indicating:
 - a. Overall dimensions including installation, operation, and service clearances.
 - b. Unit shipping, installation, and operating weights including dimensions.
 - c. Fan curves with specified operating point clearly plotted.
 - 5. Indicate mechanical and electrical service locations and requirements.
- D. Selection Samples: For each finish product specified, color chart representing manufacturer's full range of available colors.
- E. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

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- F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 FAN-COIL UNITS

- A. Manufacturers:
 - 1. Vertical Cabinet:
 - a. Carrier Corporation: www.commercial.carrier.com/#sle.
 - b. Daikin Applied: www.daikinapplied.com/#sle.
 - c. Krueger-HVAC: www.krueger-hvac.com/#sle.
 - d. Trane Technologies, PLC: www.trane.com/#sle.
 - e. Johnson Controls, Inc..
 - f. Mitsubishi Electric Corporation
- B. Performance Data and Safety Requirements:
 - 1. Unit capacities certified in accordance with AHRI 440.
 - 2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
 - 3. Insulation to comply with NFPA 90A requirements for flame spread and smoke generation.
 - 4. Equipment wiring to comply with requirements of NFPA 70.
- C. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
- D. Coils:
 - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
 - 2. Water Coil: Suitable for working temperatures not less than 200 degrees F.
 - 3. Electric-Resistance Heating Coil:
 - a. Open-wire type located in pre-heat position.
 - b. Nickel chromium element.
 - c. Interlock with fan motor switch.
 - d. Factory installed step-down transformer.
 - e. Unit mounted magnetic relays.
 - f. High temperature cutout with automatic reset to de-energize the electric heat in the event of malfunction.
 - 4. Provide drain pan under cooling coil easily removable for cleaning.
- E. Vertical Cabinet and Horizontal Exposed Units: Minimum 18 gauge, 0.0478 inch thick sheet steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.
- F. Horizontal Recessed Units:

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1. Provide with a galvanized steel cabinet, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles with minimum 18 gauge, 0.0478 inch thick sheet steel bottom panel.
2. Ducted Units: Provide with air inlet and outlet duct collars.
- G. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.
- H. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- I. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- J. Controls:
 1. Provide units with control valves furnished by the fan coil unit manufacturer.
 2. Fan Coil Unit Manufacturer's Controls:
 - a. Fan speed switch for unit mounting.
 - b. Disconnect switch.
 3. Controls Interface:
 - a. Relay board.
 - b. 24-volt transformer.
 - c. Inverting relays for use with standard thermostats and normally open valves.
- K. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

2.02 ELECTRIC UNIT HEATERS

- A. Manufacturers:
 1. INDEECO (Industrial Engineering and Equipment Company): www.indeeco.com/#sle.
 2. Modine Manufacturing Company: www.modineHVAC.com/#sle.
 3. Trane Technologies, PLC: www.trane.com/#sle.
 4. Markel.
 5. REDD-I.
 6. Raywall.
 7. Q-Mark.
 8. Berko
 9. Or Approved Equal.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
- C. Heating Element Assembly:
 1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.
 2. Horizontal Projection Units:
 - a. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.
 - b. High-mass, all steel tubular type, copper brazed, centrally located and installed in fixed element banks.
- D. Housing:
 1. Suitable for ceiling or high altitude mount using provided hardware appendages.

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2. Horizontal Projection Units:
 - a. Construction materials to consist of heavy gauge steel with galvanized, polyester powder coat, or high gloss baked enamel finish.
 - b. Provide with threaded holes for threaded rod suspension.
 - c. Provisions for access to internal components for maintenance, adjustments, and repair.
- E. Air Inlets and Outlets:
 1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
 2. Outlets: Provide diffuser cones, directional louvers, or radial diffusers.
- F. Fan: Factory balanced, direct drive, axial type with fan guard.
- G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.
- H. Controls:
 1. 24-volt auxiliary relay.
 2. Terminal block for remote control.
 3. Built-in line-voltage thermostat for wall mounted Units. Remote low-voltage thermostat for suspended units.

2.03 ELECTRIC CABINET UNIT HEATERS

- A. Manufacturers:
 1. INDEECO (Industrial Engineering and Equipment Company); _____: www.indeeco.com/#sle.
 2. Marley Engineered Products; _____: www.marleymep.com/#sle.
 3. Modine Manufacturing Company: www.modineHVAC.com/#sle.
 4. Trane Technologies, PLC: www.trane.com/#sle.
 5. Markel.
 6. REDD-I.
 7. Raywall.
 8. Q-Mark.
 9. Berko
 10. Or Approved Equal.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
- C. Heating Elements: Provide open-wire, finned tubular, or resistance wire enclosed in steel sheath.
- D. Cabinet:
 1. Minimum 18 gauge, 0.0478 inch thick steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet, and inlet grilles.
 2. Provide required hardware accessories for recessed, semi-recessed, surface, or wall mounting.
- E. Finish:
 1. Factory applied, painted finish.
 2. Color: as chosen by Architect from manufacturer's standard options..
- F. Controls:

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1. Built-in line-voltage thermostat.
- G. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.
- H. Electrical Characteristics:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Cabinet Unit Heaters:
 1. Install as indicated.
 2. Coordinate to ensure correct recess size for recessed units.
- F. Units with Electric Heating Elements:
 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 26 05 83.

3.03 CLEANING

- A. After construction and painting is completed, clean exposed surfaces of units.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

3.04 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION 23 82 00

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SECTION 23 84 16.16 - INDOOR MECHANICAL DEHUMIDIFICATION UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-source mechanical dehumidification units.

1.02 REFERENCE STANDARDS

- A. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space; 2025.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for; 2025a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2022.
- E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
- F. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.
- I. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00-Administrative Requirements # , for submittal procedures.
- B. Product Data: For each type of indoor, mechanical dehumidification unit.
 - 1. Include rated capacities, weights, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For each indoor, mechanical dehumidification unit.
 - 1. Indicate assembly, required clearances, and location and size of field connections.
- D. Delegated-Design Submittal: For indoor, mechanical dehumidification units.
 - 1. 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.
 - 2. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
- E. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

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1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

- A. See Section 01 78 00-Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturers warranty for compressors

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Dehumidification units: Self-contained, packaged, factory-assembled and -tested, refrigerant-type, indoor, mechanical dehumidification units designed for indoor installation.
- B. Performance Requirements: See Drawings for additional requirements.
- C. Electrical Characteristics:
 - 1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 05 83.

2.02 DEHUMIDIFICATION UNITS

- A. Manufacturers
 - 1. Santa Fe; www.santa-fe-products.com
 - 2. AprilAire; <https://www.aprilaire.com/>
- B. Compliance
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
 - 3. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."
 - 4. ASHRAE 15 Compliance: "Safety Standard for Refrigeration Systems."
- C. Cabinet: Formed steel casing construction with exterior powder-coated or galvanized finish, stainless-steel fasteners, knockouts for electrical and piping connections, condensate drain connection, and lifting lugs. Designed for indoor installation.
 - 1. Access: Removable panels or hinged access doors with neoprene compression gaskets and cam latches.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Condensate removal: Provide accessory condensate pump.
 - 1. Provide secondary drain pan and connection with low-voltage external float switch to shut down unit upon high water detection.
- E. Filters
 - 1. Pleated glass fiber, disposable type arranged for easy replacement:
 - a. Thickness: 1 inch.

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- F. Refrigeration System: Complete factory-charged, hermetically sealed system including:
 - 1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IES 90.1.
 - 2. Refrigerant Evaporator and Condenser Coils:
 - a. Coatings: Corrosion-resistant coating.
 - 3. Compressors: Hermetic, scroll compressors with integral vibration isolators and crankcase heaters that de-energize during compressor operation; with thermal-expansion valves, filter-dryers, sight glasses, compressor service valves, and liquid- and suction-line service valves.
 - a. Refrigerant: R-454B

2.03 CONTROLS

- A. Operating Control: On-board space humidistat cycles the compressor. Humidistat shall incorporate fan on-off-auto switch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls, floors, and roofs for suitable conditions where dehumidification units will be installed.
- C. Verify that proper power supply is available and in correct location.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
 - 2. Install in accordance with NFPA 90A and NFPA 90B.
 - 3. Install refrigeration systems in accordance with ASHRAE Std 15.
 - 4. Pipe drain from cooling coils to nearest floor drain or building exterior as shown on the Drawings. Construct deep trap at connection to drain pan, and install cleanout at changes in direction.

3.03 CLEANING

- A. Clean dehumidification units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering-air face.
- B. After completing system installation, testing, and startup service of dehumidification units, clean filter housings and install new filters.

3.04 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

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3.05 OWNER TRAINING

- A. Location: Job site
- B. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain dehumidification units.
- C. Provide minimum four (4) hours training for six (6) people.
- D. Provide video recording of the training session. Turn over video to Owner at the conclusion of the project

END OF SECTION 238416.16 23 84 16.16

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SECTION 26 05 00.02 - GENERAL PROVISIONS RELATED TO ELECTRICAL WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.
- B. The electrical work includes the furnishing of all labor, materials, accessories, and equipment required to install a complete and fully operational electrical system as shown, specified and/or reasonably implied for a complete project.

1.02 RELATED DOCUMENTS

- A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.
- B. ANSI/NFPA 70.

1.03 COORDINATION

- A. The Electrical Contractor shall coordinate his work with the other contractors in accordance with provisions of Division 1.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with NECA Standard of Installation.

1.05 FEES, PERMITS, AND INSPECTIONS

- A. Electrical Contractor shall obtain permits and arrange all inspections necessary for the installation of his work in accordance with General Conditions and furnish the Architect with certificates of inspection from all authorities having jurisdiction.
- B. Inspections and tests shall be made upon formal written notice to the Architect from the Contractor sufficiently in advance to allow representatives of the Architect and Owner to be present for each test.
- C. No construction shall be covered up or concealed until it has been inspected or approved. The Contractor shall furnish all material, labor, fuel, equipment and apparatus, and bear all expenses of such tests as are hereinafter specified for the work.
- D. Final inspection and tests shall be made in the presence of the Architect and representatives of the Owner. The tests shall be made under conditions simulating as nearly as practicable those which will be obtained in operation and shall show conclusively that the requirements of the specifications have been fulfilled. Prior to receiving final payment, the Contractor shall, in accordance with Division 1, furnish to the Architect a certificate of inspection signed by the Electrical Inspector having jurisdiction.

1.06 REGULATORY REQUIREMENTS

- A. Conform to the North Carolina State Building Code.
- B. Conform to requirements of ANSI/NFPA 70.

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- C. Conform to requirements of ANSI/IEEE C2 where applicable.
- D. Furnish products listed and classified by Underwriters Laboratories, Inc. or other North Carolina recognized third party testing agency.

1.07 QUALIFICATIONS

- A. Manufacturer: Furnish products of manufactures listed or, where substitutions are allowed, furnish products of a company specializing in manufacturing products specified with minimum of three years experience.
- B. Installation: Equipment and systems installers shall have a minimum of 5 years experience in installation of systems similar to those on this project unless indicated otherwise.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 1.

1.09 SEQUENCING AND SCHEDULING

- A. Construct work in sequence under provisions of Division 1.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Three (3) complete sets of operating and maintenance manuals shall be submitted to the Owner through the Architect/Engineer two (2) weeks prior to the pre-final inspection date.
- B. The O&M manuals shall be installed in a 3-ring heavy back note book with the name of the building and the words "Operation and Maintenance Manuals" on the cover and spine. The manuals shall contain the following items as a minimum:
 - 1. Index and page numbers.
 - 2. Certificate of substantial completion.
 - 3. All warranties.
 - 4. List of all subcontractors and suppliers with names, addresses and phone numbers.
 - 5. Certified testing and balancing report.
 - 6. Complete start-up operation, and shut-down procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items.
 - 7. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
 - 8. Equipment summary showing all capacities and ratings. (HP, Tons, KW, Filter size, etc.)
 - 9. All submittal data and shop drawings.
 - 10. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 11. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instruction.
 - 12. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly; aligning and adjusting instructions.
 - 13. Wiring and control diagrams.
 - 14. Manufacturer's cuts, part numbers, and serial numbers.

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PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIAL

- A. Equipment and material of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
- B. Equipment and material shall be new and shall bear the manufacturer's name or trade name.

2.02 DIMENSIONS

- A. The Contractor shall be responsible for insuring that items of equipment furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those of connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications.

2.03 MANUFACTURER'S DIRECTIONS

- A. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the contract documents and manufacturer's directions and shall obtain the Architect's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Architect, he shall bear all costs arising in correcting the deficiencies.

2.04 EQUIPMENT ACCESSORIES

- A. The Contractor shall provide all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner.

PART 3 EXECUTION

3.01 MATERIALS AND WORKMANSHIP

- A. All materials and workmanship shall comply with all applicable codes, specifications, state and local ordinances, industry standards, and utility company regulations. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.

3.02 LOCATION OF CONDUIT, FIXTURES, EQUIPMENT AND APPURTENANCES

- A. These locations shall be adjusted to accommodate the work to ductwork and equipment installed by other Contractors in mechanical equipment rooms and similar areas.

3.03 BUILDING AND FINISHES

- A. Building and finishes shall be protected. The Contractor will be held responsible for damage incurred and shall repair all damage done.

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3.04 SUPPORTS

- A. The Contractor shall support plumb, rigid, and true to line all work and equipment installed under this contract. The Contractor shall thoroughly study project construction drawings, shop drawings, and catalog data to determine how equipment, accessories, fixtures, and related items are to be supported, mounted, or suspended. He shall provide all bolts, inserts, brackets, structural supports, and accessories for proper support whether or not shown on the drawings.
- B. Sleeves, inserts and supports that may be required for the electrical work shall be furnished by the Electrical Contractor, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of sleeves, inserts, and supports shall be directed by the Electrical Contractor who shall also insure that they are properly installed. Sleeves shall be neatly sawed, sheared, or cut with wheeled cutters. No flame cutting will be permitted.
- C. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs as specified will be provided by the various trades in their respective materials, but the Electrical Contractor shall see that they are properly located and shall do any cutting and patching caused by the neglect to do so.
- D. Where sleeves are omitted or not provided in proper location through a concrete floor, the new holes at the proper location shall be drilled with a diamond core drill after obtaining permission from the Architect. No chiselling or other rough cutting will be permitted. No part of the building may be broken out, cut, burned out, or permanently removed.

3.05 FIRESTOPPING

- A. Firestopping of penetrations for electrical work shall be installed by Electrical Contractor.
- B. The Electrical Contractor shall be responsible for firestopping all partitions, walls and floor penetration resulting from his work. Penetrations shall be firestopped to meet or exceed rating of wall or floor systems as required by code.

3.06 COORDINATION

- A. All power wiring and associated conduit shall be provided to HVAC and Plumbing equipment by the Electrical Contractor. The HVAC and Plumbing Contractor shall furnish all motor starters, disconnect switches, and combination starters for equipment furnished under their contract and turn them over to the Electrical Contractor for installation. All final power wiring connections to equipment shall be made by the Contractor furnishing the equipment from slack wire left by the Electrical Contractor. Refer to detail, Sheet E100, of the Contract Drawings for division responsibility regarding electrical requirements.
- B. HVAC Contractor will provide all control wiring, in conduit, required to satisfactorily control all HVAC equipment; furnish and wire all control devices such as thermostats, switches, relays and any other devices necessary to control the HVAC equipment.

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3.07 PAINTING

- A. All field painting of electrical work, with exception of touch-up paint on factory finished equipment, shall be by the Electrical Contractor in accordance with the "Painting" section of these specifications. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat by the Electrical Contractor, and shall be repainted if necessary. Cut ends of steel framing channel used for equipment support shall be painted with a compound providing equivalent protection to the factory provided finish.

3.08 TESTING

- A. All test reports shall be typewritten and submitted in triplicate. Reports shall include: Item(s) tested, date of each test, name and signature of person(s) conducting test, and complete test results.
- B. Provide testing on each product or system as hereinafter specified in individual sections, and/or as recommended by product manufacturer.
- C. All test reports shall be submitted, reviewed, and approved prior to substantial completion.

3.09 CLEAN-UP

- A. The Contractor shall clean equipment, fixtures, and wiring device covers with cleaning materials appropriate to the surface and material being cleaned. Bottoms of equipment enclosures shall be cleaned to remove metal filings and other debris. All debris and excess materials shall be removed from the work area. The Contractor shall remove from the site all debris, crating, temporary facilities, waste, tools, construction equipment, machinery, and surplus materials resulting from his work.

END OF SECTION 26 05 00.02

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SECTION 26 05 10 - TEMPORARY ELECTRICAL FACILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section includes furnishing all temporary power and lighting for all trades for the construction.

1.02 POWER SOURCE

- A. The Electrical Contractor shall make all arrangements for connection of the temporary service and shall provide and maintain the temporary distribution system. The General Contractor shall pay all fees and usage charges.

1.03 RELATED DOCUMENTS

- A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.
- B. ANSI/NFPA 70.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials used shall be UL listed and shall conform to all applicable safety standards in effect at that time.
- B. Panelboards:
 - 1. Panelboards shall be in accordance with Section 26 24 16 except that plug-in circuit breakers may be used. Branch circuit breakers shall be GFCI type. Enclosures shall be NEMA Type 3R if located outside.
- C. Safety Switches:
 - 1. Safety switches shall be in accordance with Section 26 28 16 except that general duty switches may be used. Enclosures shall be NEMA Type 3R if located outside.
- D. Receptacles:
 - 1. Receptacles shall be of the grounding type and weatherproof.
- E. Lighting Fixtures:
 - 1. Lighting fixtures or lampholders shall be provided with a suitable guard to protect against accidental contact or breakage and shall be wet location labeled.
- F. Drop Cords:
 - 1. Drop cords shall be cable assemblies identified for hard or extra hard usage with suitable attachment plugs and receptacles.

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PART 3 EXECUTION

3.01 INSTALLATION

- A. Temporary wiring shall be installed in accordance with OSHA requirements and applicable sections of the NEC.

3.02 DROP CORDS

- A. Drop cords from outlet locations in excess of OSHA minimum requirements shall be provided by the other contractors to satisfy their own needs, at their own expense.

3.03 FEEDER AND BRANCH CIRCUITS

- A. Feeder and branch circuits shall be permitted to run as open conductors where voltage does not exceed 150 volts to ground and where not subject to physical damage. Open conductors shall be supported on insulators at ten foot (10') intervals.
- B. No open wiring branch circuit conductors shall be laid on the floor or ground.
- C. Receptacles shall not be installed on branch circuits which supply temporary lighting.

3.04 GROUNDING

- A. All branch circuits shall contain a separate equipment grounding conductor.

END OF SECTION 26 05 10

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SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Photovoltaic wire.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Oxide inhibiting compound.
- G. Wire pulling lubricant.
- H. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 31 00 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- D. IEEE 1210 - IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable; 2004 (Corrigendum 2014).
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

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- I. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- J. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- K. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- L. UL 4703 - Standard for Photovoltaic Wire; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
- E. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

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1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
- D. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- E. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- F. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - b. Equipment Ground, All Systems: Green.

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2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 - 1. Feeders and Branch Circuits: Stranded.
 - 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN.

2.04 PHOTOVOLTAIC WIRE

- A. Description: Sunlight-resistant, single-conductor, insulated photovoltaic wire listed and labeled as complying with UL 4703; specifically designed for interconnection wiring of photovoltaic power systems in accordance with NFPA 70.
- B. Conductor Stranding: Stranded.
- C. Insulation Voltage Rating: As required for photovoltaic power system voltage.

2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.06 ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.

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2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- C. Wire Pulling Lubricant:
 1. Listed and labeled as complying with UL 267.
 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.
- E. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

END OF SECTION 26 05 19

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 31 00 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
- D. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2025.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

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1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
 1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding System Resistance:
 1. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- E. Grounding Electrode System:
 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.

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- b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Ground Rod Electrode(s):
 - a. Provide single electrode unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - 4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 - 5. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
- F. Service-Supplied System Grounding:
- 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- G. Bonding and Equipment Grounding:
- 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

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6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
8. Provide bonding for metal building frame.
9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

H. Photovoltaic Systems: Also comply with Section 26 31 00.

I. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:

1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Manufacturers - Mechanical and Compression Connectors:
 - a. Burndy LLC
 - b. Harger Lightning & Grounding
 - c. nVent ERICO
 - d. Thomas & Betts Corporation
4. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC
 - b. nVent ERICO; Cadweld
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
 - a. Harger Lightning & Grounding:

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- b. nVent ERICO:
- c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC:
- E. Ground Rod Electrodes:
 - 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 - 4. Manufacturers:
 - a. Galvan Industries, Inc
 - b. Harger Lightning & Grounding
 - c. nVent ERICO

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Bond together the metal underground water pipe, rod electrode(s), concrete-encased electrode, building steel, metal equipment mounting rack structure, ground ring, and service equipment to the extent that these items are present at each grounding location. If there is no metal water pipe available, bond to the ductile iron force main instead.
- D. Bonding of grounding electrode conductor to rod electrodes, building steel, and concrete-encased electrodes shall be accomplished by exothermic weld process; use mechanical connections for electrodes in access wells.
- E. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground. Additional rod electrodes shall not be less than six feet apart.
- F. Make grounding and bonding connections using specified connectors.
 - 1. Equipment Grounding Conductor: Provide separate, green insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

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2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 3. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- G. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.03 EQUIPMENT AND CIRCUITS

- A. Conduit Systems:
1. Ground all metallic conduit systems.
- B. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductors to each pull box, junction box, outlet box, cabinet, and other enclosure through which the conductors pass.
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the grounding electrode and equipment grounding conductors.
 4. For metal conduit systems connect wiring device grounding terminal to outlet box with bonding jumper and to branch circuit equipment grounding conductor. Where boxes are nonmetallic, bond to equipment grounding conductor only.
 5. Grounding type insulated bonding bushings and jumpers shall be provided where conduits terminate in service entrance equipment, transformers, and where concentric, eccentric, or over-sized knockouts are encountered. The jumpers shall be sized per NEC Table 250-66 for services, generator feeders and transformers, and per Table 250.122 for branch circuits.
- C. Motors and Starters:
1. Provide lugs in motor terminal box and starter housing for equipment grounding conductor termination.
- D. Lighting Fixtures:
1. Connect equipment grounding conductor to fixture grounding terminal.
 2. Fixtures connected with flexible conduit shall have a green insulated equipment grounding conductor included with the power wires to the fixture through the flexible conduit.
- E. Electrical Appliances and Equipment:
1. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green insulated equipment grounding conductor.

3.04 CONDUCTIVE PIPING

- A. Bond all conductive piping systems in the building or at the structure which could possibly become energized to the system ground.

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3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.
- B. Equipment racks.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- C. Section 26 31 00 - Photovoltaic Collectors: Photovoltaic module mounting systems.
- D. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 30 00.

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1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports for equipment racks to include the following.
 - 1. Indicate assembly dimensions, locations of support posts, and general construction details.
 - 2. Indicate welded connections.
 - 3. Provide a Bill of Materials to include all components of the assembly.
 - 4. Indicate location and type of insulating materials.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- E. Installer's qualification statement.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Applicable building code.
 - c. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

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- d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Cable Ties:
 - 1. Manufacturer
 - a. Burndy
 - b. Gardner Bender
 - c. Panduit
 - 2. In corrosive environments: Provide grade 304 stainless steel cable ties with a low-profile clamping bearing head and fully adjustable strap accommodating many bundle diameters. Temperature range: -112°F to 1000°F.
 - 3. In non-corrosive environments: Provide Nylon 6/6 UV stabilized, weather resistant grade cable ties. Temperature range: -40°F to 185°F.
- C. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Manufacturers:
 - a. ABB; Thomas and Betts
 - b. Eaton Corporation; B-Line
 - c. Emerson Electric Co; O-Z/Gedney
 - d. nVent; Caddy
 - e. Panduit
 - 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 3. Conduit Clamps: Bolted type unless otherwise indicated.
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - 1. Manufacturers:
 - a. ABB; Thomas and Betts
 - b. Eaton Corporation; B-Line
 - c. Emerson Electric Co; O-Z/Gedney
 - d. nVent; Caddy
 - e. Panduit
- E. Metal Channel/Strut Framing Systems:
 - 1. Manufacturers:
 - a. ABB; Kindorf/Superstrut/Steel City
 - b. Atkore International Inc; Unistrut
 - c. Eaton Corporation; B-Line
 - 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 3. Comply with MFMA-4.
 - 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, PVC coated steel, or other material as indicated.
- F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- G. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

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2. Concrete: Use preset concrete inserts or expansion anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors.
 4. Hollow Masonry: Use toggle bolts or hollow wall fasteners.
 5. Hollow Stud Walls: Use toggle bolts or hollow wall fasteners.
 6. Structural Steel: Use beam clamps. Use stainless steel bolts, nuts, and washers.
 7. Sheet Metal: Use sheet metal screws.
 8. Wood: Use wood screws.
 9. Powder-actuated fasteners are permitted only as follows:
 - a. Where approved by Architect.
- H. Equipment Racks
1. All exterior electrical equipment shall be protected from the weather by means of a weather shield fabricated of 3/16" aluminum sheet. Panels shall be of one-piece construction; butt welds will not be accepted. Corner welds will be continuous. The weather shield shall be of adequate size to accommodate all equipment shown. The structure shall consist of galvanized pipe supports tied together with PVC coated steel channel for attachment of the weather shield. A suitable barrier of nylon or similar material shall be placed between dissimilar metals to prevent galvanic corrosion.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Obtain permission from Engineer before using power-actuated anchors.
- H. Equipment Support and Attachment:
 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

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3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Interior Luminaire Support and Attachment: See Section 26 51 00 for additional requirements.
 - J. Exterior Luminaire Support and Attachment: See Section 26 56 00 for additional requirements.
 - K. Secure fasteners in accordance with manufacturer's recommended torque settings.
 - L. Remove temporary supports.
 - M. Aluminum and galvanized steel surfaces in contact with concrete or grout shall have a bituminous coating.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

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SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Galvanized steel intermediate metal conduit (IMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2025.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit - Aluminum (ERMC-A); 2025.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2025.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.

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- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- N. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- R. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- S. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
 - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

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1.06 QUALITY ASSURANCE

- A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.
- B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
 - 2. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit (RMC) or rigid PVC conduit.
 - 3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) where emerging from underground.
- D. Concealed Above Accessible Ceilings: Use galvanized steel intermediate metal conduit (IMC) or galvanized steel electrical metallic tubing (EMT).
- E. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or Schedule 40 PVC.
- F. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel intermediate metal conduit (IMC) or galvanized steel electrical metallic tubing (EMT).
- G. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- H. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- I. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or Schedule 40 PVC.
- J. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or Schedule 80 PVC.
- K. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- L. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).

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2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
3. Maximum Length: 6 feet unless otherwise indicated.

M. Surface Raceways:

1. Surface-mounted raceway systems—metallic or non-metallic—marketed for architectural, decorative, or aesthetic purposes (e.g., low-profile “surface wire channels”) shall not be used for any permanent power, lighting, signal, or control installations.

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
- C. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.
- D. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuits: 3/4-inch trade size.
 2. Branch Circuit Homeruns: 3/4-inch trade size.
 3. Data: 1-inch trade size.
 4. Underground, Interior: 3/4-inch trade size.
 5. Underground, Exterior: 1-inch trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 1. Allied Tube & Conduit, a division of Atkore International.
 2. Nucor Tubular Products.
 3. Western Tube, a division of Zekelman Industries.
 4. Wheatland Tube, a division of Zekelman Industries.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 1. Allied Tube & Conduit, a division of Atkore International.

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2. Nucor Tubular Products.
 3. Western Tube, a division of Zekelman Industries.
 4. Wheatland Tube, a division of Zekelman Industries.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
 2. Material: Use steel or malleable iron.
 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International.
 2. Electri-Flex Company.
 3. International Metal Hose.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International.
 2. Electri-Flex Company.
 3. International Metal Hose.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International.
 2. Nucor Tubular Products.
 3. Western Tube, a division of Zekelman Industries.
 4. Wheatland Tube, a division of Zekelman Industries.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

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- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. ABB; Carlon.
 - 2. Allied Tube & Conduit, a division of Atkore International.
 - 3. Cantex Inc.
 - 4. Heritage Plastics, a division of Atkore International.
 - 5. JM Eagle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- D. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

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3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.
- E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- F. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 7. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 - 8. Arrange conduit to provide no more than 150 feet between pull points.
 - 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
- G. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 - 4. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
- H. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.

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4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 7. Secure joints and connections to provide mechanical strength and electrical continuity.
- I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 5. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 6. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
- K. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits may transport moisture to contact live parts.
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- L. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- M. Provide grounding and bonding; see Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

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- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 33.13

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SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.
- G. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

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- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
 - 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Keys for Lockable Enclosures: Two of each different key.

1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. CPB-ROFP-1) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 26 05 53, Electrical – Identification.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

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- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 - 3. Use suitable concrete type boxes where flush-mounted in concrete.
 - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 - 6. Use shallow boxes where required by the type of wall construction.
 - 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 - 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 - 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 - 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 - 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 - 12. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - 13. Wall Plates: Comply with Section 26 27 26.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

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1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. In non-hazardous locations, NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Non-process Area, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 4X, stainless steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
 - b. Boxes smaller than 24 inches wide by 24 inches tall: Provide screw-cover enclosures; held in place by machine screws.
 - c. Boxes 24 inches wide by 24 inches tall and larger: Provide hinged-cover enclosures; held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.
 - d. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
 - e. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolations shall be provided between the following groups:
 - 1) Power wiring
 - 2) AC control wiring
 - 3) DC control wiring
 - 4) Instrumentation wiring
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.
 5. Finish for Painted Steel Enclosures: ANSI 61 unless otherwise indicated.
 6. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
 7. Non-metallic, NEMA 7, and NEMA 9 boxes shall be provided with threaded integral conduit hubs.
- D. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size: As indicated on drawings.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 4. Applications:

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- a. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Combination fiberglass/polymer concrete boxes/enclosures are not acceptable. Use all-polymer concrete boxes/enclosures.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
 2. Unless dimensioned, box locations indicated are approximate.
 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 4. Inaccessible ceiling areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel.
 5. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
- F. Box Supports:
 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- G. Install boxes plumb and level.
- H. Install boxes as required to preserve insulation integrity.

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- I. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 6 inches deep.
 - 2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
 - J. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - K. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
 - L. Close unused box openings.
 - M. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
 - N. Provide grounding and bonding in accordance with Section 26 05 26.
- 3.03 CLEANING
- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

END OF SECTION 26 05 33.16

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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Conduit color and labels.
- G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 26 27 26 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.
- C. Section 26 31 00 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

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PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment; including room names and number.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - b. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
3. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70.
 - a. Service equipment.
 - b. Panelboards.
 - c. Industrial control panels.
4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Date label applied.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. Within boxes when more than one circuit is present.

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- b. Within equipment enclosures when conductors and cables enter or leave the enclosure.

C. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.
 - a. Maximum Intervals: 20 feet.
 - b. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
 - 1) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
 - 2) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.
 - c. Color Code:

System	Junction Box & Cover	Conduit Color	Raceway Labels	Comments
120/208 V Equipment	Galvanized	Galvanized		
Data Systems	Brown	Orange		
Fire Alarm Systems	Bright Red	Red	White	
PV Systems DC circuits	Black	Black		
Audio Visual	Blue	Galvanized		
HVAC Controls	Galvanized	Blue		
Security Control – ES	Galvanized	Yellow	Green	Card Reader System
Video Surveillance – ES	Galvanized	Yellow	Blue	Camera System
Network	Galvanized	Yellow	Yellow	Backbone that connects the security closets

3. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.

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- b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
- 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
 - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
 - 2. Markers for System Identification:
 - a. Other Systems: Type of service.
- E. Color: Black text on orange background unless otherwise indicated.

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2.05 UNDERGROUND WARNING TAPE

- A. Material: Polyethylene tape suitable for direct burial.
- B. Use nondetectable tape for open trench applications, unless otherwise indicated.
 - 1. Exception: Use detectable tape where required by utility company.
- C. Nondetectable Tape for Open Trench Applications: 6 inches wide, with minimum thickness of 4 mils, 0.0004 inch.
- D. Detectable Tape for Open Trench Applications: 4 inches wide, with minimum thickness of 5 mils, 0.0005 inch; provide integral foil core or tracer wire for detection by locator.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:
 - 1. Buried Electrical Lines: Black text on red background.

2.06 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

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- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

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SECTION 26 05 73 - POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. NEMA MG 00001 - Motors and Generators; 2024.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Study reports, stamped or sealed and signed by study preparer.

1.04 POWER SYSTEM STUDIES

- A. Scope of Studies:
 - 1. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 - 2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.

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- b. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
 - c. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - d. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - e. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
- D. Study Reports:
- 1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.

1.05 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

END OF SECTION 26 05 73

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SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Time switches.
- C. Outdoor photo controls.
- D. Lighting contactors.

1.02 RELATED REQUIREMENTS

- A. Section 25 36 26 - Integrated Automation Lighting Relays.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems
- E. Section 26 05 33.16 - Boxes for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 09 18 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote control switching relays.
- H. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- I. Section 26 51 00 - Interior Lighting.
- J. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- G. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

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- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- J. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- K. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- L. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- M. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
 - 2. Coordinate placement of wall switch occupancy sensors with installed door swings.
 - 3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
 - 4. Coordinate placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement.
 - 5. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 51 00 and lighting fixture schedule.
 - 6. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Field quality control reports.
- D. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

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1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for purpose intended.
- B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- B. General Requirements:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.
 - 5. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 6. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
- C. Wall Switch Occupancy Sensors:
 - 1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.
 - 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet.

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- D. Ceiling Mounted Occupancy Sensors:
 - 1. General Requirements:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - 2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.

2.03 TIME SWITCHES

- A. Digital Electronic Time Switches:
 - 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 - 2. Program Capability:
 - a. Astronomic Time Switches: Single channel, capable of different schedule for each day of week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 - 4. Provide automatic daylight savings time and leap year compensation.
 - 5. Provide power outage backup to retain programming and maintain clock.
 - 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - 7. Input Supply Voltage: As indicated on the drawings.
 - 8. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:

2.04 OUTDOOR PHOTO CONTROLS

- A. Locking Receptacle-Mounted Outdoor Photo Controls
 - 1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on compatible receptacle, listed and labeled as complying with UL 773.
 - 2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
 - 3. Photo Sensor: Cadmium sulfide.
 - 4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
 - 5. Voltage: As required to control load indicated on drawings.
 - 6. Failure Mode: Fails to the on position.
 - 7. Load Rating: As required to control load indicated on drawings.
 - 8. Surge Protection: 160 joule metal oxide varistor.
 - 9. Provide the following accessories where indicated or as required to complete installation:
 - a. Receptacle: Complying with ANSI C136.10.
 - b. Mounting Bracket.

2.05 LIGHTING CONTACTORS

- A. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated 3-pole 20 amp unless otherwise indicated..
- B. Lighting contactor shall be electricall operated and mechanically held.

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- C. Enclosures:
 - 1. Comply with NEMA IA 10030.
 - 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 3. Finish: Manufacturer's standard unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 05 33.16.
- C. Maintain separation of remote-control, signaling, and power-limited circuits.
 - 1. See manufacturer instructions and Section 26 05 19 for control wiring conductors, wiring methods, and identification requirements.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Provide required supports; see Section 26 05 29.

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- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.
- J. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- D. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

END OF SECTION 26 09 23

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SECTION 26 21 00.01 - UTILITY SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Arrangement with Utility Company for permanent electric service.
- B. Underground service entrance.

1.02 RELATED SECTIONS

- A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.
- B. Section 260532 - Conduit.
- C. Section 260526 - Grounding and Bonding.

1.03 REFERENCES

- A. ANSI/NFPA 70.

1.04 SYSTEM DESCRIPTION

- A. Utility Company: Duke Energy
- B. System Characteristics. 208 Y/120 volt, 3-phase, 4-wire.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with Utility Company requirements.

1.06 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record locations of service entrance feeder and equipment to include utility company pad mounted transformer if applicable. Location dimensions shall be indicated from at least two above ground locations. Record distance of transformer from building.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

PART 2 PRODUCTS

2.01 PAD MOUNTED TRANSFORMER

- A. Pad mounted transformer, and primary wiring shall be provided by the Utility Company.
- B. Transformer Pad shall be provided by Contractor to Utility Company specifications.

2.02 UTILITY METERS

- A. Meter and base will be provided by Utility Company and mounted to the transformer enclosure.

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- B. Contractor shall coordinate installation of pulse demand type meter by utility company and connection of Building Automation System conductors to meter by Mechanical Contractor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that service equipment is ready to be connected and energized.

3.02 PREPARATION

- A. Make arrangements with Utility Company to obtain permanent electric service to the Project.
- B. Coordinate location of Utility Company's facilities to ensure proper access is available.

3.03 INSTALLATION

- A. Install service entrance conduit from Utility Company's pad-mounted transformer to building service entrance equipment. Coordinate conduit stub ups below transformer with pad by Contractor. Connect service lateral conductors to service entrance equipment. Utility Company will make connections at transformer.

END OF SECTION 26 21 00.01

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SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- E. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2025.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

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- N. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 4. Include documentation of listed series ratings upon request.
 - 5. Identify mounting conditions required for equipment seismic qualification.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

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2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB
- B. Eaton Corporation
- C. Schneider Electric
- D. Siemens Industry, Inc
- E. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Listed series ratings are acceptable only where specifically indicated.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

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- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 4X, stainless steel.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: ANSI 61 unless otherwise indicated.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- H. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- I. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list and label panelboards as a complete assembly including surge protective device.
- J. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
- K. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type.
 - 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Provide clear plastic circuit directory holder mounted on inside of door.

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2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Copper.
 - 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
 - 6. Do not use handle ties in lieu of multi-pole circuit breakers.
 - 7. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
 - 8. Provide the following features and accessories where indicated or where required to complete installation:

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- a. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.06 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- F. Provide grounding and bonding in accordance with Section 26 05 26.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- G. Install all field-installed branch devices, components, and accessories.
- H. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- I. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- J. Provide filler plates to cover unused spaces in panelboards.
- K. Identify panelboards in accordance with Section 26 05 53. Provide "Do Not Work on Hot Panel" signage on panelboards

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

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- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

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SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates and covers.
- E. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- E. Section 27 10 00 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

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1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 4. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Operation and Maintenance Data:
 - 1. GFCI Receptacles: Include information on status indicators.
- D. Project Record Documents: Record actual installed locations of wiring devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.
- B. Wiring Device Applications:
 - 1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
 - 2. Provide GFCI protection for:
 - a. Receptacles installed within 6 feet of sinks.
 - b. Receptacles installed in kitchens.
 - c. Receptacles serving electric drinking fountains.
- C. Wiring Device Finishes:
 - 1. Provide wiring device finishes as described below, unless otherwise indicated.

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2. Wiring Devices, Unless Otherwise Indicated: Gray with smooth brushed stainless steel wall plate.
3. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate unless it is a fully generated building.

2.02 WALL SWITCHES

- A. General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- C. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.03 WALL DIMMERS

- A. Manufacturers:
 1. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
 2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.
 3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
- B. General Requirements:
 1. 0-10V Dimmer Specifications: Operating Voltage: Dual 120V/277V AC (60 Hz) is standard.
 2. Control Signal: 0–10 V DC, Class 2 compliant. Dimming Range: 10% to 100% (dependent on driver capability).
 3. Current Sink Capacity: Commonly 20mA to 100mA, with some models handling up to 200mA.
 4. This allows controlling multiple LED drivers per circuit. Control Wiring: Requires two additional low-voltage wires (typically Purple: +10V, Gray: Ground).
 5. Switching Capacity: Often features a built-in relay to switch line voltage (e.g., 1200W @ 120V or 1660W @ 277V).
 6. Compatibility: Works with 0-10V compliant LED drivers and fluorescent ballasts.
 7. Control: Slide control type with separate on/off switch.

2.04 RECEPTACLES

- A. General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
- B. Convenience Receptacles:

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1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
- C. GFCI Receptacles:
 1. General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R.
 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.05 WALL PLATES AND COVERS

- A. Wall Plates: Comply with UL 514D.
 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- B. Device plates for indoor flush mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.
- C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

2.06 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
 1. Hubbell Incorporated
 2. Thomas & Betts Corporation
 3. Wiremold, a brand of Legrand North America, Inc
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.

2.07 POKE-THROUGH ASSEMBLIES

- A. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.
- B. Die-cast aluminum cover with Saitn Nickel finish.
- C. Flush Floor Service Fittings:
 1. Concealed Services Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle(s) with hinged door opening(s).
 2. Dual Concealed Services Combination Outlets:
 - a. Cover: Hinged door(s).

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- b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s).
 - 2) Voice and Data Jacks: Provided by others.
- 3. Accessories:
 - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

2.08 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Receptacles: 18 inches above finished floor or 6 inches above counter.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

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- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- I. Install wall switches with OFF position down.
- J. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- K. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- O. Identify wiring devices in accordance with Section 26 05 53.
- P. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

END OF SECTION 26 27 26

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SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- H. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

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- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- D. Project Record Documents: Record actual locations of enclosed switches.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings. Disconnect switches for hazardous areas shall be UL 1203 listed.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

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- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor. Where a grounded (neutral) conductor is shown on the drawings in the conduits connected to the disconnect switch, a manufacturer-supplied neutral bar shall be furnished for termination of the grounded conductors. Third party ground lug and neutral lug kits not supplied by the disconnect switch manufacturer are not acceptable.
- L. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Non-process Area, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 4X, Type 304 stainless steel.
 - 2. Finish for Painted Steel Enclosures: ANSI 61 unless otherwise indicated.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides "finger-safe" protection when the door of the enclosed switch is open.
- O. Disconnect switches for all motors connected to variable frequency drives (VFDs) shall be furnished with a factory installed electrical interlock kit that includes one (1) early-break auxiliary contact rated for 5A (minimum) at 120 VAC to be used to open the control circuit before the main switch blades break.
- P. Heavy Duty Switches:
 - 1. Comply with NEMA BS 31047.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

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- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Identify enclosed switches in accordance with Section 26 05 53.

END OF SECTION 26 28 16.16

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SECTION 26 31 00 - PHOTOVOLTAIC COLLECTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Photovoltaic system requirements.
- B. Photovoltaic modules.
- C. Photovoltaic module mounting system.
- D. Photovoltaic combiner boxes.
- E. Photovoltaic inverters.
- F. Monitoring system.

1.02 REFERENCE STANDARDS

- A. IEC 61215-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1: Test Requirements; 2021, with Corrigendum.
- B. IEC 61215-1-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-1: Special Requirements for Testing of Crystalline Silicon Photovoltaic (PV) Modules; 2021.
- C. IEC 61215-1-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-2: Special Requirements for Testing of Thin-Film Cadmium Telluride (CdTe) Based Photovoltaic (PV) Modules; 2021, with Amendment (2022).
- D. IEC 61215-1-3 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-3: Special Requirements for Testing of Thin-Film Amorphous Silicon Based Photovoltaic (PV) Modules; 2021, with Amendment (2022).
- E. IEC 61215-1-4 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-4: Special Requirements for Testing of Thin-Film Cu(In,Ga)(S,Se)₂ Based Photovoltaic (PV) Modules; 2021, with Amendment (2022).
- F. IEC 61215-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 2: Test Procedures; 2021.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- H. NECA 412 - Standard for Installing and Maintaining Photovoltaic (PV) Power Systems; 2025.
- I. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1699B - Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection; Current Edition; Current Edition, Including All Revisions.
- L. UL 1703 - Flat Plate Photovoltaic Modules and Panels; Current Edition, Including All Revisions.

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- M. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Certify that work of this section does not void roof warranty.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with Utility Company requirements for interconnection.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Photovoltaic Inverters:
 - 1. Solar Edge.
- B. Monitoring System:
- C. Source Limitations: For each type of component, furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 PHOTOVOLTAIC SYSTEM REQUIREMENTS

- A. Provide complete photovoltaic system consisting of photovoltaic modules and associated balance of system components necessary for connection to facility electrical system.
- B. System Description:
 - 1. Photovoltaic array is roof-mounted in location indicated on the drawings.
 - 2. Orientation of array is South.
 - 3. System does not include battery storage system.
 - 4. System does not include engine generator.
 - 5. System includes monitoring system.
- C. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of the installed location.

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- D. Provide photovoltaic system and associated components suitable for continuous operation under the service conditions at the installed location.
- E. Provide products listed, classified, and labeled as suitable for the purpose intended.
- F. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.
- G. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with UL 1699B as required for compliance with NFPA 70.
- H. Rapid Shutdown of Photovoltaic Systems on Buildings: Provide listed equipment arranged to provide rapid shutdown in accordance with NFPA 70.
- I. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- J. Arrange array to minimize shading during peak production periods.
- K. Roof-Mounted Arrays:
 - 1. Arrange array such that normal roof drainage is not affected.
 - 2. Arrange array to maintain required safety clearances from edges of roof as indicated.
 - 3. Arrange array to maintain access and clearance requirements for other roof-mounted equipment.
 - 4. Arrange array to avoid spanning of expansion joints.

2.03 PHOTOVOLTAIC MODULES

- A. Acceptable Module Types: Either crystalline silicon or thin film modules complying with specified requirements will be considered for this project.
- B. General Requirements:
 - 1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 600 V DC; complying with IEC 61215-1 and IEC 61215-2 and listed as complying with UL 1703.
 - 2. Crystalline Silicon Photovoltaic Modules: Comply with IEC 61215-1-1.
 - 3. Thin Film Photovoltaic Modules: Comply with IEC 61215-1-2, IEC 61215-1-3, or IEC 61215-1-4 as applicable.
 - 4. Frame: Anodized aluminum.
 - 5. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
 - 6. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.
 - 7. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).

2.04 BALANCE OF SYSTEM COMPONENTS

- A. Photovoltaic Module Mounting System:
 - 1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in the location indicated, including all necessary hardware and accessories.

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2. Support Structure and Associated Hardware Materials: Use aluminum, galvanized steel, or stainless steel.
3. Roof-Mounted Arrays:
 - a. Provide system compatible with the roof at the installed location.
 - b. Module Tilt Angle: As required to provide maximum energy production for installed location.
 - c. Provide minimum clearance of 3 inches between roof and module for air circulation and drainage.
- B. Photovoltaic Inverters:
 1. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
 2. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with UL 1741; furnished with the following features:
 - a. Maximum power point tracking (MPPT).
 - b. LCD display.
 3. Total Harmonic Distortion: Less than five percent.
 4. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
- C. Monitoring System:
 1. Provide a system to monitor photovoltaic system performance including all sensors, dataloggers, connections, software, equipment and accessories necessary for a complete operating system.
 2. System communications interfaces to be wired or wireless, with compatible interconnected components.
 - a. Provide suitable raceway, minimum 3/4 inch trade size, for all required wired connections.
 3. System to monitor and record, in 15 minute intervals:
 - a. Inverter status.
 - b. Instantaneous power (kW).
 - c. Cumulative energy production (kWh).
 4. System real-time and historical data to be accessible from the following locations:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Use open circuiting, short circuiting, or opaque covering to disable modules, array or portions of array prior to installation and service.
- B. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage.

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3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment in accordance with Section 26 05 29.
- D. Mount equipment such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor, ground, or working platform.
- E. Circuiting Requirements. in Addition to Requirements of Section 26 05 19:
 - 1. Wiring Methods:
 - a. Unless otherwise indicated, use exposed module factory-installed cables (not routed inside building) for module interconnections.
 - b. Secure exposed cables in accordance with NFPA 70. Where possible, conceal behind array.
 - 2. Photovoltaic DC System Conductor Color Code:
 - a. Negative Grounded System:
 - 1) Positive: Red.
 - 2) Negative/Grounded: White.
 - b. Positive Grounded System:
 - 1) Positive/Grounded: White.
 - 2) Negative: Black.
 - 3. Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with NFPA 70.
- F. Grounding and Bonding Requirements, in Addition to Requirements of Section 26 05 26:
 - 1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.
 - 2. Provide auxiliary electrodes for photovoltaic array grounding in accordance with NFPA 70.
- G. Identification Requirements, in Addition to Those Specified in Section 26 05 53:
 - 1. Use identification nameplate or means of identification acceptable to authority having jurisdiction to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means. Locate at main service disconnecting means and at each photovoltaic system disconnecting means. Verify format and descriptions with authorities having jurisdiction.
 - 2. Use identification nameplate to identify each photovoltaic system disconnecting means with text "PV SYSTEM DISCONNECT".
 - 3. Use identification nameplate or identification label to identify systems equipped with rapid shutdown and associated rapid shutdown switch(es). Format, descriptions, and locations to comply with NFPA 70 and requirements of authorities having jurisdiction.
 - 4. Use identification nameplate or identification label to identify the information required by NFPA 70 for marking of direct-current photovoltaic power sources. Locate at each DC disconnect means requiring marking.

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5. Use identification nameplate or identification label to identify the interactive system point of interconnection at the disconnecting means as a power source and with the rated AC output current and the nominal operating AC voltage.
6. Use warning labels to identify electrical hazards for photovoltaic system disconnecting means. Include the word message "Warning - Electric Shock Hazard; Terminals on the line and load sides may be energized in the open position" or approved equivalent.
7. Use wire and cable markers to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
8. Use voltage markers, identification labels, stenciled text, or suitable permanent marking approved by authority having jurisdiction to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies with the text "Warning: Photovoltaic Power Source" at maximum intervals of 10 feet in accordance with NFPA 70.

END OF SECTION 26 31 00

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SECTION 26 43 00 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 24 16 - Panelboards.

1.03 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
 - 1. SPDs with EMI/RFI filter: Include noise attenuation performance.
- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

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- D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
 - 1. UL 1449.
 - 2. UL 1283 (for Type 2 SPDs).
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- G. Project Record Documents: Record actual connections and locations of surge protective devices.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide minimum 20 year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Field-Installed, Externally Mounted Surge Protective Devices:
 - 1. ABB; Current Technology
 - 2. ASCO; Advanced Protection Technologies
 - 3. Eaton
 - 4. Schneider Electric
 - 5. Surge Suppression, LLC (SSI)
- B. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Source Limitations: Provide surge protective devices produced by single manufacturer and obtained from single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

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- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
 - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 1. Indoor clean, dry locations: Type 1.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Surge Protective Device - Basis of Design: Surge Suppression, LLC (SSI); Advantage Series; Model CSEB (240 kA/phase, Type 2, I-n = 20 kA, with advanced electrical noise filter).
 - 1. Voltage: As indicated on drawings.
 - 2. Features: Discrete "all-mode" protection (10 modes for 3-phase wye circuits); component-level thermal fusing; internal circuit board-mounted overcurrent fusing; 200 kAIC SCCR; 25 year warranty.
 - 3. Include the following options:
 - a. AC11 - Advanced internal audible alarm with on, off, and test with dry relay contacts.
 - b. D1 - NEMA 1, 2, 3, 3S, 4X, and 12 composite enclosure with integral non-fused disconnect switch, with external handle

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

- A. Surge Protective Device - Basis of Design: Surge Suppression, LLC (SSI); Advantage Series; Model CDLB (180 kA/phase, Type 2, I-n = 20 kA, with advanced electrical noise filter).
 - 1. Voltage: As indicated on drawings.
 - 2. Features: Discrete "all-mode" protection (10 modes for 3-phase wye circuits); component-level thermal fusing; internal circuit board-mounted overcurrent fusing; 200 kAIC SCCR; 25 year warranty.
 - 3. Include the following options:
 - a. AC11 - Advanced internal audible alarm with on, off, and test with dry relay contacts.
 - b. D1 - NEMA 1, 2, 3, 3S, 4X, and 12 composite enclosure with integral non-fused disconnect switch, with external handle

2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

- A. Surge Protective Device - Basis of Design: Surge Suppression, LLC (SSI); Advantage Series; Model SKLD (120 kA/phase, Type 1, I-n = 20 kA).
 - 1. Voltage: As indicated on drawings.

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2. Features: Discrete "all-mode" protection (10 modes for 3-phase wye circuits); component-level thermal fusing; internal circuit board-mounted overcurrent fusing; 200 kAIC SCCR; 25 year warranty.
3. Include the following options:
 - a. AC10 - Basic internal audible alarm with dry relay contacts.
 - b. D1 - NEMA 1, 2, 3, 3S, 4X, and 12 composite enclosure with integral non-fused disconnect switch, with external handle

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify system grounding and bonding is in accordance with Section 26 05 26, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 05 26 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

3.04 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

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END OF SECTION 26 43 00

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SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.
- E. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- J. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

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1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 5-year manufacturer warranty for LED luminaires, including drivers.
- C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.
- D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.

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- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- G. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory high impact polycarbonate vandal shields for fixtures within reach of floors and all outdoor locations.
 - 3. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

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2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
 - 1. Self-Powered Exit Signs:
 - a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
 - c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - d. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- C. Accessories:
 - 1. Provide compatible accessory high-impact polycarbonate vandal shields for fixtures within reach of floors and all outdoor locations.

2.05 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Architectural Trims for LED Lighting:
 - 1. Description: Trims designed for integration into architectural elements, with channels to accommodate LED tape lighting system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

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3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 5. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
- I. Suspended Luminaires:
 - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
- J. Wall-Mounted Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to center of luminaire.
 - 2. Installed in stairwells.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Exit Signs:

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1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - O. Identify luminaires connected to emergency power system in accordance with Section 26 05 53.
 - P. Install lamps in each luminaire.
- 3.04 FIELD QUALITY CONTROL
- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
 - B. Inspect each product for damage and defects.
 - C. Operate each luminaire after installation and connection to verify proper operation.
 - D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
 - E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.
- 3.05 ADJUSTING
- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
 - B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
 - C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.
- 3.06 CLEANING
- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- 3.07 CLOSEOUT ACTIVITIES
- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

END OF SECTION 26 51 00

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SECTION 28 46 00 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.

1.03 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authorities having jurisdiction.
- B. BAS: Building automation system.
- C. EoL: End-of-line.
- D. EVACS: Emergency voice/audio communication systems.
- E. FACU: Fire alarm control unit.
- F. HVAC: Heating, ventilation, and air conditioning.
- G. IDC: Initiating device circuit.
- H. LAN: Local area network.
- I. NAC: Notification appliance circuit.
- J. NPLFA: Non-power-limited fire alarm.
- K. PLFA: Power-limited fire alarm.
- L. SLC: Signaling line circuit.
- M. SOO: Sequence of operation.

1.04 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. NECA 305 - Standard for Fire Alarm System Job Practices; 2018.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2027.

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- G. NFPA 1225 - Standard for Emergency Services Communications; 2022.
- H. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.
- I. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.
- J. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.
- K. UL 1711 - Amplifiers for Fire Protective Signaling Systems; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Evidence of designer qualifications.
- C. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification information.
- D. Design Documents: Submit all information required for plan review and permitting by AHJ, including floor plans, riser diagrams, and description of operation.
 - 1. Copy (if any) of list of data required by AHJ.
 - 2. NFPA 72 "Record of Completion", filled out to extent known at time.
 - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A, and complete listing of software required.
 - 4. Manufacturer's detailed product data sheet for each component, including wiring diagrams, and circuit length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.
 - 5. Certification by manufacturer of FACU that system design complies with Contract Documents.
 - 6. Certification by Contractor that system design complies with Contract Documents.
- E. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.
 - 1. System zone boundaries and interfaces to fire safety systems.
 - 2. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 3. Include elevations and details of proposed equipment arrangements.
 - 4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
 - 5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and EoL and power supervisory devices.
 - 6. Include requirements and control diagrams for interfacing with other systems.
 - 7. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; standby and spare capacity calculations; notification appliance circuit loop resistance and voltage drop calculations, including spare capacity.
 - 8. List of devices and notification appliances on each SLC, with spare capacity indicated.

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9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 11. Detailed drawing of graphic annunciators, displays, and interfaces.
 12. Certification by either FACU manufacturer or manufacturer of related equipment.
 13. Certification by FACU manufacturer that system design complies with Contract Documents.
 14. Certification by Contractor that system design complies with Contract Documents.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test," filled out.
- H. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by AHJ.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 8. Detailed but easy to read explanation of procedures require recording of system trouble events by qualified personnel, such as when routine testing is being conducted for fire drills and when entering into contracts for building renovations.
- I. Project Record Documents: See Section 01 7800 for additional requirements, have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, and updated input/output chart.
 - a. ECS: Voice messages by event.
- J. Closeout Documents:
1. Certification by manufacturer that system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion," filled out completely and signed by installer and authorized representative of AHJ.

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1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 305.
- C. Handle carefully to avoid damage to internal components, enclosure, and finish.
- D. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.
- C. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

1.08 WARRANTY

- A. Fire Alarm Control Units and Accessory Equipment: Provide minimum 3-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- B. Fire Alarm Manual Pull Stations: Provide minimum 1-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- C. Fire Alarm System Detectors: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- D. Fire Alarm System Notification Appliances: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

- A. General Requirements:
 - 1. Provide new fire alarm system complying with NFPA 70, NFPA 72, NFPA 90A, and consisting of required equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as necessary for complete operating system that provides functional intent indicated.
 - 2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. 36 CFR 1191 and ADA Standards.
 - b. Requirements of AHJ.

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- c. Applicable local codes.
- d. Contract Documents.
- e. NFPA 72; "should" is mandatory; where conflicts between requirements require deviation, identify deviations clearly on design documents.
- 3. Fire Alarm System Products:
 - a. Listed, classified, and labeled as suitable for purpose intended.
 - b. Installation Environments: Provide products suitable for their respective indoor and outdoor applications.
- 4. Provide fire alarm circuits in accordance with NFPA 70.
 - a. Comply with methods of interconnecting FACUs in accordance with NFPA 72 and NFPA 70.
 - b. Power Sources:
 - 1) Comply with requirements for power supplies of emergency systems in accordance with NFPA 70.
 - 2) Primary: Dedicated branch circuits from facility power distribution system.
 - 3) Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.
 - c. Wiring and Wiring Methods:
 - 1) General Requirements:
 - (a) Comply with requirements for wiring and wiring methods in accordance with NFPA 70.
 - (b) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed and labeled as suitable for use in return air plenums.
 - (c) Special Occupancies: Comply with NFPA 70.
 - (d) Comply with NFPA 70 for wire and cable plenum, riser, general-purpose, limited-use, undercarpet, and underground applications.
 - 2) Fire Alarm Circuits:
 - (a) Comply with NFPA 70 for conditions and types required for multiconductor cable systems.
 - (b) Non-Power-Limited Fire Alarm (NPLFA) Circuits:
 - (1) Provide dedicated NPLFA non-GFCI branch circuits for fire alarm equipment and marked by red identification in accordance with NFPA 70.
 - (c) Power-Limited Fire Alarm (PLFA) Circuits:
 - (1) Provide identification for PLFA circuits in accordance with NFPA 70.
- 5. Provide pathway class designations and pathway survivability, as defined in NFPA 72.
 - a. Provide monitoring of conductors and other signaling channels for integrity and circuit performance.
 - b. Pathway Class Designations:
 - 1) Unless otherwise indicated or required, pathways to meet the following requirements:
 - (a) SLCs: Class B (star, tee-tap, multi-tap, with no return).
 - (b) IDCs: Class B (daisy-chain with EoL resistor device installed at end of circuit).

B. Fire Alarm System Interfaces and Control Functions:

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1. UL 864 listed unless otherwise indicated.
2. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.
3. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.

2.02 FIRE ALARM CONTROL UNITS AND RELATED EQUIPMENT

- A. Manufacturers:
 1. Notifier, By Honeywell Inc
 2. Edwards Systems Technology(EST)
 3. FCI
- B. Fire Alarm Control Units and Related Equipment: Listed and labeled as complying with UL 864.
- C. Provide cabinets and enclosures as indicated or as required to house system components.
- D. Fire Alarm Control Unit (FACU): Addressable.
 1. SLCs and IDCs: Configurable for Class B or Class A with additional modules.
 2. NACs: Integral and programmable with synchronization modules or cards as required.
 3. Power Supply: 120 VAC, 60 Hz, supplying necessary power for FACU.
 4. User-Interface: Touchscreen display for system interfacing and service mode settings, include password and user credentials; configurable for custom actions and incorporates historical event log.
 5. Support self-testing detector capability.
 6. Remote Annunciator Support: Up to 10.
- E. Emergency Communications System (ECS):
 1. Comply with NFPA 1225.
 2. Amplifiers listed and labeled as complying with UL 1711.
- F. Alarm Communication:
 1. Protected Premises Alarm and Signaling Systems:
 - a. Provide accessories as required for interface as indicated and as required by AHJ.
 - b. Provide accessories in accordance with building code, fire code, and life safety code requirements for occupancy classifications and use cases.
 - c. Include software and firmware control, required features, special requirements for low-power radio (wireless) systems, and fire alarm system interconnections required by NFPA 72.
 2. Products:
- G. Remote Annunciators:
 1. LCD Remote Annunciators:
 - a. Provide backlit LCD display that mimics FACU display.
 - b. Provide dedicated status indications for power and alarm, supervisory, and trouble conditions.
 - c. Enable system control functions including acknowledge, silence, and reset.
 - d. Provide local audible alarm.

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- e. Mounting: Wall-mounted; provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.

2.03 FIRE ALARM SYSTEM INITIATING DEVICES

A. General Requirements:

1. Addressable Systems:

- a. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs.
 - b. Conventional/Nonaddressable Devices: Provide addressable interface modules as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring point for each device in order to be individually identifiable by addressable FACU.
- 2. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable interface modules only in clean, dry, indoor, nonhazardous locations.
 - 3. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
 - 4. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.
 - 5. Devices for Hazardous/Classified Locations: Listed and labeled as suitable for classification of installed location.
 - 6. Protective Covers for Fire Alarm Devices: See "Accessories" below.

B. Manual Fire Alarm Boxes/Pull Stations:

- 1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
- 2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
- 3. Operation: Dual-action unless otherwise indicated or required.
 - a. Dual-Action Operation: First requires pushing, pulling, or lifting, then pulling of lever.
- 4. Color: Red, in accordance with NFPA 72.
- 5. Station Reset: Requires use of key or tool.

C. Duct Smoke Detectors:

- 1. Listed and labeled as complying with UL 268A.
- 2. Ratings: Compatible with air velocity, temperature, and humidity requirements for installed duct.
- 3. Housing: Select as required for application.
- 4. Sampling Tubes: Select as required for installation in duct to be monitored.

2.04 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

A. General Requirements:

- 1. Provide signaling notification appliances listed for fire-protective service and intended operating mode, public or private; suitable for connection to FACU notification appliance circuits.

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2. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (e.g. ceiling, wall).
3. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
4. Concealed Notification Appliances:
 - a. Upon activation from fire alarm system, expose device for operation; return to concealed position upon system deactivation; motor-driven.
 - b. Provide door position monitoring system for remote indication of concealed and exposed positions.
5. Exterior Notification:
 - a. In addition to required occupant notification, provide notification appliances on exterior of building.
6. Notification Appliance Derating: Include device derating adjustments in accordance with listing where applicable, including the following.
 - a. Where accessory protective guards or enclosures are utilized.
 - b. Where required by field conditions (e.g., ambient temperature and sound).
7. Notification Appliance Color:
 - a. Wall-Mounted: Red.
 - b. Ceiling-Mounted: White.
 - c. See drawings for mounting configuration indicated by symbols on floor plans, system interconnection diagrams, and details.

2.05 WIRE AND CABLE

- A. General Requirements:
 1. Comply with NFPA 70 listing and marking requirements for cables.
 2. Substitution of fire alarm listed cables for communication wiring, in accordance with NFPA 70, is not permitted.
 3. Provide cables as indicated or as required for connections between system components.
- B. Power-Limited Fire Alarm Cables (PLFA):
 1. Comply with applications of listed cables in accordance with Chapter 7 of NFPA 70.
 - a. Fire alarm cable substitutions in accordance with NFPA 70: Permitted.
- C. Non-Power-Limited Fire Alarm Cables (NPLFA):
 1. Comply with NPLFA circuit conductor properties in accordance with NFPA 72.
 2. Comply with listing requirements in Chapter 7 of NFPA 70.

2.06 ACCESSORIES

- A. Provide components as indicated or as required for connection of fire alarm system to devices and other systems indicated.
- B. Provide EoL resistors as required for wiring supervision.
- C. Protective Covers for Fire Alarm Devices:
 1. Listed to same standard as device being protected.
 2. Outdoor Covers: Weather resistant, suitable for outdoor use; use only with outdoor-rated devices.
 3. Provide guards to protect devices where subject to mechanical damage; listed for use with detector.

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- a. Protective Covers for Manual Pull Stations:
 - 1) Provide protective covers with hinged access for manual pull stations where indicated.
 - 2) Listed and labeled as complying with UL 38.
- D. Framed Passive Graphic Maps:
 - 1. Provide passive graphic maps, size as indicated or as required by AHJ.
 - 2. Identify information required by AHJ, including the following:
 - a. Location of FACUs and remote annunciators.
 - b. Current location, labeled "YOU ARE HERE."
 - c. North reference.
 - 3. Utilize nomenclature consistent with FACU programming and device identification labels.
 - 4. Provide concealed mounting hardware.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that system capacities listed in manufacturer instructions align with designed system.
- B. Verify that mounting surfaces are ready to accept components and equipment, with suitable support frames and anchors installed where required.
- C. Verify ratings, configurations, and characteristics of system components.
- D. Verify rough-ins for field connections.
- E. Verify that work likely to damage fire alarm system has been completed.
- F. Verify that interior of building has been protected from weather.
- G. Perform preinstallation tests and inspections per manufacturer's instructions and in accordance with NECA 305.
- H. Verify that system bonding is in accordance with Section 26 05 26.
- I. Do not energize system until deficiencies have been corrected.
- J. Verify that branch circuit wiring installation is completed, tested, and ready for connection to fire alarm system. Overcurrent protection ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

3.02 PREPARATION

- A. Prior to installation, confirm environment of installation area is clean, and with ambient temperature, humidity, and ventilation requirements are per manufacturer's written instructions.
 - 1. Clean and vacuum in accordance with manufacturer's written instructions. Confirm equipment ventilation holes are absent of obstructions and free for air flow.
 - 2. Clean pathways thoroughly to remove foreign materials before installing conductors and cables.
 - 3. Clean dirt, debris, plaster, and other foreign materials from equipment enclosures, cabinets, and outlet boxes.

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4. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Follow tool requirements for installation, including torquing adjustments, as listed in manufacturer documentation.
- C. Remove detector dust covers prior to system energization.

3.03 INSTALLATION

- A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:
- B. Field Locations:
 1. Obtain Owner's approval of locations of devices and notification appliances before installation.
 2. Arrange equipment to provide minimum operational clearances and required maintenance access in accordance with manufacturer's instructions and NFPA 70.
 3. Conceal wiring, conduit, outlet boxes, and supports where installed in finished areas; maintain code-required access.
- C. Raceways and Supports:
 1. Coordinate locations of outlet boxes as required for installation. Only install boxes and equipment at locations based on application standards indicated in NFPA 72.
 2. Secure and support raceways at intervals complying with NFPA 70. Provide supports where vertical rise exceeds permissible limits.
 3. Install firestopping to preserve fire resistance rating of partitions and other elements.
- D. Wiring and Connections:
 1. Maintain separation of Class 1, Class 2, Class 3 remote-control, signaling, fire alarm circuits, and power-limited circuits in accordance with cable insulation class and NFPA 70.
 2. Maintain circuit pathway and class designations in accordance with NFPA 72 for configuration, separation, and survivability.
 3. Comply with permitted and not permitted installations for wires, cables, cable routing assemblies, communications circuits, and fire alarm circuits in accordance with NFPA 70.
 4. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by AHJ. Provide independent support from building structure and suspended ceiling systems. Do not provide support from raceways, piping, ductwork, or other systems.
 5. Provide grounding and bonding in accordance with Section 26 05 26.
 6. Comply with manufacturer's minimum cable sizes or ratings.
 7. Do not exceed manufacturer's recommended maximum power, signal, or network cable lengths between components.
 8. Provide network wiring in accordance with NFPA 70.
 9. Neatly train and bundle conductors inside boxes, wireways, and cabinets.
 10. See manufacturer's instructions for batteries.
- E. Fire Alarm System Components:
 1. Install field-installed devices, components, relays, notification appliances, accessories, and when applicable EoL resistors.

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- a. Install wiring to supervisory devices and associated EoL resistors as required for supervision of hardwired connections
 2. Install Wall-Mounted Equipment: Assemble component hardware within (e.g., card bays, sub-bays, expansion bays, signal cards, other card frames, networking, signal transmission, application modules, tamper monitoring devices, interconnecting modules, and auxiliary power supplies), including space for required spare capacity, and configure settings.
 3. Install Interconnect Wiring: Connect system cabinets, install processor and cards, cabling, connectors, terminations, and bonding.
- F. Branch Power:
1. After installation confirmations, follow manufacturer instructions to connect branch circuit power cables to premises fire alarm system components; comply with NFPA 70.
 2. Where accessories require auxiliary power, provide control power source and monitoring as indicated or as required to complete installation.
 3. Install auxiliary power supplies, including indicated monitoring, and connections necessary for remote equipment.
- G. System Identification:
1. Identify devices, notification appliances, components, cables, and equipment in accordance with approved submittals. See Section 26 05 53.
 2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
 3. Mark location of disconnecting means for NPFLA circuits.
 4. Coordinate to provide red branch power circuit protective devices or identify them accordingly as required by NFPA 72 and NFPA 70.
 5. Mark date of batteries installed on inside cover of panels and formal maintenance logs.
- H. Troubleshooting and Installer Checks:
1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.
 2. Check system operation for notification, FACU functions, circuit supervision, alarm initiating devices, supervisory initiating devices, dress panels/doors/covers, and programming before performing field tests.
- I. Fire Alarm System Tests:
1. Perform required tests of NFPA 72. Record measured values during operational checks.
 2. Confirm functional testing of fire alarm system is as indicated in Contract Documents.

3.04 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify AHJ and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide services of installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required.

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- E. Provide tools, software, and supplies required to accomplish inspection, testing, and document results.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of AHJ; document each inspection and test.
- G. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals for additional submittals.
- B. See Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Closeout Demonstration: Demonstrate operation of all functions to Owner.
 - 1. Be prepared to conduct any of required tests.
 - 2. Have minimum one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 - 3. Have authorized technical representative of FACU manufacturer present during demonstration.
 - 4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
 - 5. Repeat demonstration until successful.

END OF SECTION 28 46 00

SECTION 313116 – TERMITE CONTROL

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. Soil treatment.
- B. Related Requirements:
 - 1. Section 06 1000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles for termite control products.
 - 2. Include the EPA-Registered Label for termiticide products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

1.6 FIELD CONDITIONS

- A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading and concreting operations. Treat soil under footings, grade beams and ground-supported slabs before construction.

1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
 1. Service Life of Treatment: Soil treatment termiticide that is effective for not less than **five** years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

3.3 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
 - 3. Masonry: Treat voids.
 - 4. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.
- B. Post warning signs in areas of application.
- C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

- A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

END OF SECTION 313116