

**MCPHERSON SQUARE LIBRARY
RENOVATIONS AND PARK
IMPROVEMENTS
TECHNICAL SPECIFICATIONS
DIVISIONS 02-33
APRIL 14, 2026**

SECTION 024119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.
3. Removal of items for conservation purposes, using an Owner approved conservator.

B. Related Requirements:

1. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
2. Section 013591 "Historic Treatment Procedures".
3. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
4. Section 017300 "Execution" for cutting and patching procedures.
5. Section 017419 "Construction Waste Management and Disposal"

1.2 DEFINITIONS

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

1.3 MATERIALS OWNERSHIP

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
2. Coordination for shutoff, capping, and continuation of utility services.

1.5 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or

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verification of criteria compliance from approved third-party program. Highlight relevant information.

5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.6 FIELD CONDITIONS

- A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

1.7 QUALITY ASSURANCE

- A. Owner Approved Conservator:

1. Cleaning and restoration of plaques at main entrance vestibule shall be carried out by a conservator approved by the Owner. Select conservator from the list below, provided by the Owner.

a. Heritage Conservation Collective, LLC
Marco Federico
marco@conservationhc.com
www.conservationhc.com

b. Kreilick Conservation, LLC
Margaret McGonigle
mmcgonigle@kreilickconservation.com
www.kreilickconservation.com

c. Lee Dunsmore - Sculptural Services, LLC
[Lee Dunsmore | LinkedIn](#)
267-259-5027

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.
- C. Sustainable Design Requirements for Building Reuse:
 1. Maintain the existing building structure, envelope, and interior nonstructural elements of a historic building or contributing building in a historic district. Do not demolish such existing

- construction beyond indicated limits.
- 2. Maintain the existing building structural systems where indicated to remain. Do not demolish such existing construction beyond indicated limits.
- 3. Maintain the existing interior ceilings, interior partitions, and/or demountable walls where indicated to remain. Do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs. Comply with Section 013233 "Construction Photographs."
 - 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
 - 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

- A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition areas.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
 1. Arrange to shut off utilities with utility companies.
 2. If disconnection of utilities and building systems will affect adjacent occupied parts of the site, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
 3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.
 4. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.
 - a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
 5. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:
 - a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
 - b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

- A. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse.

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

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 4. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

- C. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

3.8 CLEANING

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

3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Remove and Reinstall:
 - 1. Security fences on top of outdoor mechanical enclosure and side entrance.
 - 2. Plaques at main entrance vestibule shall be removed for cleaning and restoration. This work shall be done by the contractor using the services of a conservator approved by the Owner. Plaques shall be reinstalled by the Contractor following conservation at locations indicated on Drawings.
 - 3. Other items as may be indicated on Drawings.

END OF SECTION 024119

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
2. Steel reinforcement bars.
3. Welded-wire reinforcement.
4. Form-facing material for cast-in-place concrete.
5. Shoring, bracing, and anchoring.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, 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.
- C. 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.
- D. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Silica fume.
5. Aggregates.
6. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
7. Each type of steel reinforcement.
8. Epoxy repair coating.
9. Bar supports.

10. Exposed surface form-facing material.
11. Concealed surface form-facing material.
12. Forms for cylindrical columns.
13. Void forms.
14. Form ties.
15. Form-release agent.
16. Vapor retarders.
17. Floor and slab treatments.
18. Curing materials.
19. Joint fillers.
20. Repair materials.

B. Sustainable Design Submittals:

1. Environmental Product Declarations
 - a. For cement, slag, and steel reinforcement: Product-specific declaration or Industry-wide EPD or product-specific EPD.
 - 1) Include EPD Summary.
2. Sourcing of Raw Materials
 - a. For products having recycled content (slag and steel): Documentation indicating percentages by weight of pre-consumer and post-consumer recycled content. Include material cost value.
 - b. For products having regionally sourced recycled material (slag, steel): Documentation indicating locations of recovery, manufacture, purchase of recycled raw materials.
3. Material Ingredients
 - a. For admixtures and coatings, if available: Material Ingredient Report
4. Low-Emitting Materials
 - a. For interior wet-applied coatings: Certificate stating compliance with California Department of Public Health (CDPH) Standard Method including TVOC range.
 - 1) Include product data stating VOC content in grams per Liter (grams per Liter (g/L)).
 - 2) Include volume of material applied per product in liters (L).

C. 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. Intended placement method.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Steel Reinforcement 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.

- E. Formwork 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.
- F. 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.
- G. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
- B. Qualification Statements: For testing and inspection agency.
- C. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Semirigid joint filler.
 9. Joint-filler strips.
 10. Repair materials.
 11. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- D. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.

2. Fly ash.
3. Slag cement.
4. Silica fume.
5. Aggregates.
6. Admixtures:
7. 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.
8. Mechanical splice couplers.

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. Field quality-control reports.

1.5 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.

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."

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

1.7 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 for three successive days, 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 surfaces less than 35 deg F, other than reinforcing steel.

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.

1.8 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 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.
 - a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.3 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. Metal or other approved panel materials (at ramp walls).
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1 at new basement stair walls, and as follows:
 - 1) APA MDO (medium-density overlay); mill-release agent treated 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 not exceeding specified formwork surface class.
 - 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.4 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- C. Epoxy-Coated Reinforcing Bars:
 - 1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
 - 2. Epoxy Coating: ASTM A775/A775M with less than 2 percent damaged coating in each 12-inch bar length.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, plain steel.

2.5 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, 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, 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.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: ASTM A884/A884M, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch wire length.
- E. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.
- F. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

2.6 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, gray.
 - 2. Fly Ash: ASTM C618, Class C or F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 - 4. 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: As indicated on drawings.
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.

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

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Stego Industries, LLC.
 - b. W. R. Meadows, Inc.

2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. 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.
- C. Curing Paper: Eight-foot-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- D. Water: Potable or complying with ASTM C1602/C1602M.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. 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.

- C. 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.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. 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.
- G. 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.

2.10 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.

2.11 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.

2.12 CONCRETE MIXTURES FOR STRUCTURAL ELEMENTS

- A. Proportion normal-weight concrete mixtures as follows:
 - 1. Exposure Class: As indicated on drawings.
 - 2. Minimum Compressive Strength: As indicated on drawings.
 - 3. Maximum w/cm: As indicated on drawings.
 - 4. Slump Limit: 4 inches or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Air Content: As indicated on drawings.
 - 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.13 FABRICATING REINFORCEMENT

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

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

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

3.3 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 and Section 033300 "Architectural Concrete".
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 2. 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 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.

3.4 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.

3.5 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, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 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.

3.6 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.

3.7 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, 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.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 48 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 welded-wire reinforcement in longest practicable lengths.
 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 4. Lace overlaps with wire.
- H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

3.8 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches 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 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.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - 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.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. 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.

3.10 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.
2. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

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

3.11 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 or to receive mortar setting beds for bonded cementitious floor finishes.

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 and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 7. Finish 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 unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.
- E. 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.
- F. 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.

3.12 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches 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: 5000 psi (for exterior locations) or 4000 psi (for interior locations) 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.

3.13 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.
 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.
 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.
- 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) 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.
- c. Floors to Receive Curing and Sealing Compound:
 - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.14 TOLERANCES

- A. Conform to ACI 117.

3.15 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 seven days' old or per the product manufacturer's specifications.
 - 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.

3.16 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(s).
 - 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. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 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.

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 0.01 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 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 approval, using epoxy adhesive and patching mortar.

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

3.18 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 testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 - 1. Steel-reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.

6. Verification of concrete strength before removal of shores and forms from beams and slabs.
 7. Batch Plant Inspections: On a random basis, as determined by Architect.
 8. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
- 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 50 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. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. 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.
 5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure three sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of three laboratory-cured specimens at seven days and one set of three specimens at 28 days. Test additional specimens at 56 days if the set of three specimens at 28 days do not meet or exceed the required compressive strength
 - b. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
 7. 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.
 8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 9. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. 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 48 hours of completion of floor finishing and promptly report test results to Architect.

3.19 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 035416

HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.2 ACTION SUBMITTALS

- ###### **A. Shop Drawings:** Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.3 LEED SUBMITTALS

- ###### **A. LEED Environmental Reporting Form:** For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. **Product Material Cost:** Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. **Product Data for Credit - Environmental Product Declarations (EPD):** For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. **Product Data for Credit - Sourcing of Raw Materials:** For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.

- c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
- 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
- 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Test Reports:
 - 1. For fire-resistant ratings, from a qualified testing agency.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
 - 1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product listed below or equal product from another manufacturer:
 - a. SikaLevel® Self Leveling Underlayment
- B. Water: Potable and at a temperature of not more than 70 deg F.
- C. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement, if required and as recommended in writing by underlayment manufacturer.
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
 - 1. VOC Content: Provide coating with VOC content of 250 g/L or less.
 - 2. Low-Emitting Materials: Coating shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.
 - 1. Emissions Requirements: Coating shall comply with either of the following:
 - a. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - b. VOC Content: Provide coating with VOC content of 100 g/L or less.
- F. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

3.2 PREPARATION

- A. Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
- C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Mix and install underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
 - 2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Install underlayment to produce uniform, level surface.
 - 1. Install a final layer without aggregate to product surface.
 - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 INSTALLATION TOLERANCES

- A. Finish and measure surface, so gap at any point between hydraulic cement underlayment surface and an unlevelled, freestanding, 10-foot- long straightedge resting on two high spots and

placed anywhere on the surface does not exceed 3/16 inch .

3.5 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 040120
MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes repointing joints with mortar.

1.2 RELATED SECTIONS

- A. Section 040120.63 "Brick Masonry Repair"
- B. Section 042000 "Stone Masonry and Unit Masonry"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

- A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for brick masonry repointing work.
- B. Stone Masonry Repointing Specialist Qualifications: Engage an experienced stone masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for stone masonry repointing work.
- C. Mockups: Prepare mockups of brick masonry repointing and stone masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare a mockup for each type of material requiring repointing.
 - 1. Repointing: Rake out joints in two separate areas for each material, each area approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide, or as dimensionally appropriate for the area of work, for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cemex S.A.B. de C.V.
 - b. Lehigh Hanson; HeidelbergCement Group.
 - c. Quikrete; The QUIKRETE Companies, LLC.
- B. Water: Potable.

2.2 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Do not use admixtures in mortar unless otherwise indicated.
- C. Mixes: Mix mortar materials in the following proportions:
 - 1. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to masonry cement.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Remove miscellaneous hardware adjacent to masonry and store during masonry repointing. Reinstall when repointing is complete.

3.2 REPOINTING

- A. Rake out and repoint joints to the following extent:
 - 1. All joints in areas indicated on Drawings or requiring repointing.
 - 2. Joints at locations of the following defects:
 - a. Holes and missing mortar.
 - b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
 - c. Cracks 1/8 inch (3 mm) or more in width and of any depth.
 - d. Hollow-sounding joints when tapped by metal object.
 - e. Eroded surfaces 1/4 inch (6 mm) or more deep.
 - f. Deterioration to point out that mortar can be easily removed by hand, without tools.

- g. Joints filled with substances other than mortar.
- B. Do not rake out and repoint joints where not required.
- C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
 - 1. Remove mortar from joints to depth of 2 times joint width and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.
 - 2. Remove mortar from brick and other masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 - 3. Do not spall edges of brick or other masonry units or widen joints. Replace or patch damaged brick or other masonry units as directed by Architect.
- D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Pointing with Mortar:
 - 1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
 - 2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
 - 3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
 - 4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
 - 5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 - 6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.
- F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

END OF SECTION 040120

SECTION 040120.63
BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes, but may not be limited to, repairing brick masonry at the mechanical enclosure on the north façade and at the existing stair to the basement on the west side.

1.2 DEFINITIONS

- A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.3 RELATED SECTIONS

- A. SECTION 040120.64 "Brick Masonry Repointing"
- B. SECTION 017419 "Construction Waste Management and Disposal"

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and locations of replacement bricks on the structure.
 - 2. Show provisions for expansion joints or other sealant joints.
- C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

- A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

- A. Face Brick: As required to complete brick masonry repair work.

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040120.63-1
BRICK MASONRY REPAIR

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork.
 - a. Brick at existing mechanical enclosure to match existing.
 - b. Brick at existing stair to basement to match existing.
 - c. Physical Properties: According to ASTM C67 and as follows:
 - 1) Grade: SW.
 - 2) Type: FBS.
 - 3) Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi.
 - 4) Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
 - 5) Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 - d. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.
2. Special Shapes:
 - a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
 - c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

- B. Building Brick: ASTM C62, Grade SW where in contact with earth or Grade SW, MW, or NW for concealed backup; and of same vertical dimension as face brick, for masonry work concealed from view.

2.2 MORTAR MATERIALS

- A. Masonry Cement: ASTM C91/C91M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cemex S.A.B. de C.V.
 - b. Lehigh Hanson; Heidelberg Cement Group.
 - c. Quikrete; The QUIKRETE Companies, LLC.

2.3 MANUFACTURED REPAIR MATERIALS

- A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cathedral Stone Products, Inc.
 - b. Conproco Corporation.
 - c. Edison Coatings, Inc.
2. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than bricks being repaired, and develops high bond strength to all types of masonry.
3. Formulate patching compound in colors and textures to match each brick being patched.

2.4 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.
- B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
 1. Previous effectiveness in performing the work involved.
 2. Minimal possibility of damaging exposed surfaces.
 3. Consistency of each application.
 4. Uniformity of the resulting overall appearance.
 5. Do not use products or tools that could leave residue on surfaces.

2.5 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Do not use admixtures in mortar unless otherwise indicated.
- C. Mixes: Mix mortar materials in the following proportions:
 1. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to masonry cement.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Remove accessories during masonry repair. Reinstall when repairs are complete.

3.2 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Remove in an undamaged condition as many whole bricks as possible.
 - 1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
 - 2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
- F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
- G. Replace removed damaged brick with other removed brick in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.
- H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
 - 1. Maintain joint width for replacement units to match existing joints.
- I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.) Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
 - 1. Rake out mortar used for laying brick before mortar sets according to Section 040120.64 "Brick Masonry Repointing." Point at same time as repointing of surrounding area.
 - 2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

3.3 BRICK MASONRY PATCHING

- A. Patching Bricks:
 - 1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.
 - 2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.

3. Rinse surface to be patched and leave damp, but without standing water.
4. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
5. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
6. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
7. Keep each layer damp for 72 hours or until patching compound has set.

3.4 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.
 1. Do not use metal scrapers or brushes.
 2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120.63

SECTION 042000

STONE MASONRY AND UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Brick.
4. Stone masonry.
5. Mortar and grout materials.
6. Reinforcement.
7. Ties and anchors.
8. Accessories.
9. Mortar and grout mixes.
10. Cleaning and restoration of arch and sculptural ornamentation at front entrance.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.

C. Related Requirements:

1. Section 040120 "Masonry Repointing".
2. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

C. Stone Masonry: Locally sourced stone to match vocabulary of existing construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.
3. Stone masonry shall match variety, colors, texture, size, shape of existing and dressed to match the existing surface profile.

C. Conservation Plan:

1. Detailed description of conservation work proposed for arch and sculptural ornamentation above door at front entrance.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of the following:
1. Masonry units.
 - a. Include data on material properties.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
 - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include name of manufacturer, brand name, and type.
 3. Mortar admixtures for unit masonry and stone masonry (to match hardness).
 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 5. Grout mixes. Include description of type and proportions of ingredients.
 6. Reinforcing bars.
 7. Joint reinforcement.
 8. Anchors, ties, and metal accessories.
- B. Qualification Statements: For testing agency.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test 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.
- 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. Qualifications:
1. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.
- B. Owner Approved Conservator:
1. Cleaning and restoration of arch and sculptural ornamentation above front entrance shall be carried out by a conservator approved by the Owner. Select conservator from the list below, provided by the Owner.

a. Heritage Conservation Collective, LLC
Marco Federico
marco@conservationhc.com
www.conservationhc.com

b. Kreilick Conservation, LLC
Margaret McGonigle
mmcgonigle@kreilickconservation.com
www.kreilickconservation.com

c. Lee Dunsmore - Sculptural Services, LLC
[Lee Dunsmore | LinkedIn](#)
267-259-5027

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 32 inches down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 32 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F 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.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain exposed masonry units cementitious mortar components and mortar aggregate from single source, producer, or manufacturer.
- B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.
- C. For stone masonry, obtain range of stone sizes and colors from single, local source to match existing stone.

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.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, 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 ft. vertically and horizontally of a walking surface.

- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C90, normal weight.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
 2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 LINTELS

- A. Solid Concrete Masonry Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength of not less than that of CMUs.
- B. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 032000 "Concrete Reinforcing," and with reinforcing bars indicated.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
- B. Building (Common) Brick: ASTM C62, Grade MW or Grade SW.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2500 psi.
 2. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

3. Application: Use where brick is indicated.

2.7 STONE MASONRY

- A. General: Provide a matching variety of shapes and colors per field verification and as follows, with exposed surfaces fitting into existing color and shape pattern of exposed faces of surrounding masonry.
 - a. Provide appropriately shaped and/or cut stones for corners and masonry forming bed under capstone where indicated.

2.8 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 will not be 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. Masonry Cement: ASTM C91/C91M.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Holcim (US) Inc.
 - b. Lafarge North America Inc.
 - c. Lehigh White Cement Company.
 - d. Quikrete; The QUIKRETE Companies, LLC.
 - e. Sakrete; CRH Americas, Oldcastle APG.
- E. Mortar Cement: ASTM C1329/C1329M.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Lafarge North America Inc.
- F. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, sand, and admixtures and complying with ASTM C1714/C1714M.
 1. Preblended Dry Portland Cement Mortar Mix:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Quikrete; The QUIKRETE Companies, LLC.
 - 2) Sakrete; CRH Americas, Oldcastle APG.

G. Aggregate for Mortar: ASTM C144.

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 thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.

J. Water: Potable.

2.9 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Heckmann Building Products, Inc.
 - b. Hohmann & Barnard, Inc.
 - c. Wire-Bond.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. [Hohmann & Barnard, Inc.](#)
- b. [Wire-Bond.](#)

E. Masonry-Joint Reinforcement for Multiwythe Masonry:

- 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Heckmann Building Products, Inc.](#)
 - b. [Hohmann & Barnard, Inc.](#)
 - c. [Wire-Bond.](#)
- 2. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches wide, plus one side rod at each wythe of masonry 4 inches wide or less.
- 3. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch cover on outside face.

2.10 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
 - 2. Stainless Steel Wire: ASTM A580/A580M, Type 304.
 - 3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 - 4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 - 1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long for masonry constructed from solid units.
 - 2. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire.
- D. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
 - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

2.11 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.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vents: Use the following unless otherwise indicated:
 - 1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.
- E. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
 - b. PROSOCO, Inc.

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 mortar unless otherwise indicated.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Mortar for Stone Masonry: mortar is to match existing in color, hardness, texture, and joint tooling.
- E. 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 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C476, paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

2.13 CONSERVATION AND CLEANING MATERIALS

- A. For work above main entrance, utilized conservation materials that match existing materials as closely as possible. Utilize cleaning materials that will not damage in place construction and that are appropriate for existing substrates.
- B. Provide materials as required for complete cleaning and restoration of existing ornamentation.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch 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 ft., or 1/2-inch 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.

Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch 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. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 - 3. 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 CMUs hollow brick as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
 - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- C. Set stone, or cast-stone, trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
 - 4. Rake out mortar joints for pointing with sealant.
- D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated. Tool joints in stone masonry walls to match existing adjacent surfaces.
- F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- G. Cut joints flush where indicated to receive waterproofing and/or air barriers 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 on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 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 inch 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 o.c. vertically and 36 inches o.c. horizontally.

3.8 LINTELS

- A. Install steel lintels where indicated or required.
- B. Provide concrete, masonry, or offset angle support lintels where indicated and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 WEEP HOLES

- A. General: Install weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/cavity vent products to form weep holes.
 - 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
 - 3. Space weep holes 24 inches o.c. unless otherwise indicated.
 - 4. Space weep holes formed from plastic tubing 16 inches o.c.
 - 5. Trim wicking material flush with outside face of wall after mortar has set.

3.10 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- 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 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 48 inches.

3.11 CLEANING AND CONSERVATION WORK

- A. Carry out cleaning and conservation work in a manner that does not damage existing surrounding construction, that is in compliance with reviewed conservation plan, and that results in an appropriately conserved final product.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. 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 will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
 - 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. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
- D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- E. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.13 REPAIRING, POINTING, AND CLEANING

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

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

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.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 044300
SITE STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Boulders.

1.3 RELATED REQUIREMENTS

- A. Section 321316 –Concrete Paving.
- B. Section 321216 "Asphalt Paving" for new asphalt pavement.

1.4 SUBMITTALS

- A. Photographs: Submit photos with dimensions of proposed boulders. Landscape Architect will review boulders in person at the quarry if located within 50 miles of Philadelphia.
- B. Product Data and Samples: For each type of product indicated:
 - 1. Aggregate base.
 - 2. Geotextile.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Stone: Obtain boulders from one quarry.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 60

PART 2 - PRODUCTS

2.1 BOULDERS

- A. Quarry Boulders. Mica Schist, irregular shape, various sizes, max. 3'l x 2'w x 2'h, min. 2'l x 18" w x 18" h. Can be obtained from Media Quarry, or locally sourced. Color range to include gray, blue and brown.

2.2 SETTING BED AND JOINT MATERIALS

- A. Aggregate base: 2A modified stone.
- B. Geotextile: Separation Geotextile from Typar, 1 (800) 541-5519, www.typargeosynthetics.com Typar landscape fabric Style 3201, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive boulders, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 SETTING OF STONE MASONRY, GENERAL

- A. Perform necessary field cutting and trimming as stone is set.
- B. Sort boulders before installation to remove stones that do not comply with requirements relating to aesthetic effects or that are otherwise unsuitable for intended use.
- C. Arrange stones as indicated on Drawings.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Landscape Architect.
 - 2. Defective joints.
 - 3. Stone masonry not matching approved samples and mockups.
 - 4. Stone masonry not complying with other requirements indicated.
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement
- C. In-Progress Cleaning: Clean boulders as work progresses, washing off dust and dirt.
- D. Final Cleaning: upon completion of installation, clean boulders by buck and brush hand-cleaning methods to remove loose dirt and debris.

END OF SECTION 044300

SECTION 051200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors, shop welded.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.
2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1.2 DEFINITIONS

- ###### **A. Structural Steel:** Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

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 LEED SUBMITTALS

- ###### **A. LEED Environmental Reporting Form:** For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. **Product Material Cost:** Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. **Product Data for Credit - Environmental Product Declarations (EPD):** For all products that meet EPD requirements, EPDs with relevant sections highlighted.

3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

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. Etching cleaner
7. Shop primer.
8. Galvanized-steel primer.
9. Galvanized repair paint.
10. 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 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).

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Mill test reports for structural-steel materials, including chemical and physical properties.
- D. 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.
- E. Survey of existing conditions.
- F. 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. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

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 360.
 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Angles: ASTM A572/A572M, Grade 50.
- C. Channels:
 1. Less than 8" deep: ASTM A36/A36M.
 2. 8" or deeper: ASTM A992/A992M.
- D. Plate and Bar:
 1. 4" thick or less: ASTM A572/A572M, Grade **50**.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 1. Weight Class: As indicated on drawings..
 2. Finish: Black except where indicated to be galvanized.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, 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, compressible-washer type with plain finish.

- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, 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, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Plain.
- D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.
- B. Threaded Rods: ASTM A36/A36M.
 - 1. Nuts: ASTM A63 heavy-hex carbon steel.
 - 2. Washers: ASTM A36/A36M carbon steel.
 - 3. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50.

2.5 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 2. 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: ASTM A780/A780M.

2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 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, 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 3.
- 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. Welded-Steel Door Frames: Build up welded-steel door frames 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 o.c. unless otherwise indicated on Drawings.
- H. 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.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: As indicated on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation 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 3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. 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.

2.11 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. 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.

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. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 3. 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.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- 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: As indicated on drawings.
- 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. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

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.

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.

END OF SECTION 051200

SECTION 055200

METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless steel railings.
2. Stainless steel guardrails, including typical height guardrails and custom stair enclosure with anti-climb section above guardrail height.
3. Stainless steel handrails.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Handrail brackets.
3. Nonshrink, nonmetallic grout.
4. Anchoring cement.
5. Metal finishes.

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

C. Samples: For each type of exposed finish.

D. Delegated Design Submittal: For all guardrails and railings noted on drawings, including attachments to existing and new construction elements. Delegated design submittal shall include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Welding certificates.

1.4 LEED SUBMITTALS

- ###### **A. LEED Environmental Reporting Form:** For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 QUALITY ASSURANCE

- A. Comply with ASCE "Specifications for the Design of Cold-Formed Stainless Steel Structural Members."
- B. Sustainability and LEED Standards:
 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 3. Sustainable Agriculture Network's Sustainable Agriculture Standard

4. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.1-2010
5. California Air Resources Board (CARB) 2007
6. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

C. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachments 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 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.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 STAINLESS STEEL RAILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Julius Blum & Co., Inc.
 2. VIVA Railings, LLC.

- 3. Wagner Companies (The); R&B Wagner, Inc.
- B. Pipe: ASTM A312/A312M, Grade TP 316L.
- C. Castings: ASTM A743/A743M, Grade CF 8M or CF 3M.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Stainless Steel Railing Components: Type 316 stainless steel fasteners.
- B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 RAILING INFILL PANELS

- A. Guardrail Infill Panels
 - 1. Application: Lower Stair Enclosure and Accessibility Ramp.
 - 2. Basis of Design Product: Subject to compliance with requirements, provide Feeney Stainless Steel Metal Mesh Panel Infill.
 - 3. Style: Metropolitan.
 - 4. Color: Silver.
- B. Anti-Climb Fence Infill Panels
 - 1. Application: Upper Stair Enclosure.
 - 2. Basis of Design Product: Subject to compliance with requirements, provide Omega Max Anti-climb Fencing.
 - 3. Standard height: 96 3/16" (2442 mm), stackable.
 - 4. Standard length: 93 3/16" (2366 mm).
 - 5. Finish: Pre-galvanized and polyester powder coated, color: silver-gray (RAL 7001).
 - 6. Mesh Spacing: 1/2" x 3" (12.7 mm x 76.2 mm).
 - 7. Gauge: Horizontal wire: 1 x 8 GA (4 mm) + 1 additional wire 8 GA (4 mm) every c/c 6" (152.4 mm). Vertical wire: 1 x 8 GA (4.00 mm).
 - 8. Square Post: Dimensions 3" or 4".
 - 9. Brackets: Flat Bar (±1/2" (12.7 mm) allowance) with tamper proof nut Spider bracket (±1/2" (12.7 mm) allowance) with tamper proof self drilling screws.
 - 10. Caps: Standard square cap.
 - 11. Gate Height: Custom, 84".

2.6 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast stainless 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.

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.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- 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. 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.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
- D. Form changes in direction as follows:
 1. As detailed.
- E. 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.
- F. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- G. 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.

- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- I. 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.
- J. 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.
- K. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
 - 1. Provide socket covers designed and fabricated to resist being dislodged.
 - 2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.8 STAINLESS STEEL FINISHES

- A. Stainless Steel Pipe and Tubing Finishes:
 - 1. Brushed, satin, directional #4 finish.
- B. Comply with NAAMM's "Metal Finished for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 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.

2.10 ANCHORING POSTS

- A. 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.

2.11 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
- B. Secure wall brackets and railing end flanges to building construction as follows:
 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.

2.12 CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055213

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preserved-treated lumber.
3. Fire-retardant-treated lumber.
4. Dimension lumber framing.
5. Miscellaneous lumber.

B. Related Requirements:

1. Section 092300 "Gypsum Plastering" for interior finish plastering patches and repairs.
2. Section 064100 "Architectural Wood Casework" for custom fabricated interior wood casework.
3. Section 062023 "Interior Finish Carpentry" for interior wood trim and moldings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preserved 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.

B. Sustainable Design Submittals:

1. Chain-of-Custody Qualification Data: For manufacturer and vendor.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

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2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

B. Certified Wood: All wood provided under this Section shall be FSC Certified. Provide an invoice, including vendor's chain-of-custody number, product cost, and entity being invoiced.

C. Vendor Qualifications: Provide proof of use of vendors that are certified for chain of custody by an FSC-accredited certification body.

1.6 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: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. Dimension Lumber Items:

1. Grade: Construction or No. 2 .
2. Species: Any of the following species:
 - a. Hem-fir (north); NLGA.
 - b. Mixed southern pine or southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - f. Western woods; WCLIB or WWPA.
 - g. Northern species; NLGA.
 - h. Eastern softwoods; NeLMA.

C. Concealed Boards:

1. Lumber Moisture Content: 19 percent maximum.
2. Species and Grade: Any of the following:
 - a. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - b. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 - c. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - d. Eastern softwoods; No. 2 Common grade; NeLMA.
 - e. Northern species; No. 2 Common grade; NLGA.
 - f. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

D. Wood Blocking: For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. Wood Furring: For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

PART 3 - EXECUTION

3.1 INSTALLATION OF ROUGH CARPENTRY, GENERAL

- 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 and similar supports to comply with requirements for attaching other construction.
- C. Metal Framing Anchors: Install anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 ft. 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. Field Application of Preservative Treatment: Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron (SBX) for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. Flexible Flashing: 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. 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

- A. Install wood blocking where indicated on Drawings 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.

3.3 INSTALLATION OF WOOD FURRING

- A. Install wood furring level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally at 24 inches o.c.

3.4 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 062023

INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Interior paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.
 - a. Show large-scale details.
 - b. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

C. Samples: For each exposed product and for each color and texture specified.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113.20 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

- A. Sustainability and LEED Standards:
 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 4. Forest Stewardship Council (FSC)
 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
 6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
 7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011
- B. Certified Wood: All wood provided under this Section shall be FSC Certified. Provide an invoice, including vendor's chain-of-custody number, product cost, and entity being invoiced.
- C. Vendor Qualifications: Provide proof of use of vendors that are certified for chain of custody by an FSC-accredited certification body.

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.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.
- D. Particleboard: ANSI A208.1, Grade M-2.

2.2 INTERIOR TRIM

- A. Lumber Trim for Opaque Finish (Painted Finish):
 - 1. Species and Grade: Any closed grain hardwood.
 - 2. Maximum Moisture Content: 15 percent.
 - 3. Finger Jointing: Allowed.
 - 4. Face Surface: Surfaced (smooth).
 - ~~0. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.~~
- ~~C.B.~~ Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."
 - 1. Softwood Moldings: MMPA WM 4, P grade.
 - a. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
 - b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
 - 2. Finger Jointing: Allowed.
 - 3. Pattern: Match existing trim in profile and dimension.

2.3 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. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 24 inches long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 6. Install trim after gypsum-board joint finishing operations are completed.
 - 7. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
 - 8. Fasten to prevent movement or warping.
 - 9. Countersink fastener heads on exposed carpentry work and fill holes.

END OF SECTION 062023

SECTION 064100

ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-veneer-faced casework for transparent finish.
2. Casework hardware.
3. Countertops and supports.
4. Aluminum rack system.
5. Periodical display.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud-framing required for anchoring cabinets.

1.2 COORDINATION

- ###### A.
- Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.
 - a. Show large-scale details.
 - b. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - c. Show locations and sizes of cutouts and holes for items installed in architectural cabinets.
 - d. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

- ###### C.
- Samples for Verification: Provide a minimum of three samples showing the full range of color and/or grain to be expected in the finished work, for the following.

1. Lumber for Transparent Finish: Not less than 8 inches long by 3/4 inch thick, and as wide as practical, 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 cabinets. Samples to show the full range of color and grain to be expected.
3. Veneer Panel for Transparent Finish: 8 by 8 inches by 1/4 inch, representative of and selected from flitches to be used for transparent-finished casework.
4. Simulated Stone Countertops: 8 by 8 inches, for each type, color, pattern, and surface finish required.
5. Provide one Sample applied to core material with specified edge material applied to one edge for each type of edge condition.
6. Provide one Sample applied to core material with each type and color of tack surface.
7. Provide one Sample of each type of accessory hardware.

D. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Product Data: Verify compliance with requirements for Forest Stewardship Council U.S. (FSC).
3. Laboratory Test Reports: For composite wood products, indicating compliance with the formaldehyde emissions evaluation.
4. Product Data: For installation adhesives, indicating VOC content.
5. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.
6. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.4 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating

percentages, by weight, of post-consumer and pre-consumer recycled content.

4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

B. Certified Wood: All wood provided under this Section shall be FSC Certified. Provide an invoice, including vendor's chain-of-custody number, product cost, and entity being invoiced.

C. Manufacturer Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Provide proof of use of vendors that are certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: 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 levels planned for building occupants during the remainder

of the construction period.

- B. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, comply with ANSI/AWI 0641 for duty level and grade of architectural cabinets indicated for construction, finishes, installation, and other requirements.

2.2 WOOD-VENEER-FACED CASEWORK FOR TRANSPARENT FINISH

- A. Architectural Woodwork Institute (AWI) Standard:

1. Aesthetic Performance Grade: Premium-.
2. Product Data: Verify materials were fabricated within 100 miles of Project site from materials that have been extracted, harvested, or recovered within 100 miles of Project site.
3. Certified Wood: Verify wood products are certified as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.
4. Verify adhesives have a VOC content of 30 g/L or less.

- B. Casework Construction Type: Frameless.

- C. Door and Drawer-Front:

1. Design: Flush panel.
2. Style: Flush overlay.

- D. Exposed Exterior Surfaces: As indicated on Drawings.

1. **Species: White oak.**
2. Cut: Rift sawn.
3. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
4. Veneer Matching:
 - a. Matching of Veneer Leaves: Book match.
 - b. Veneer Matching within Panel Face: Running match.
 - c. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
5. Edgeband: Solid wood matching exposed surfaces.
6. Outside Corners: Solid wood matching exposed surfaces to the extent indicated on the drawings.

- E. Exposed Interior Surfaces:

1. Provide TFL interiors on back panels, bottom panels, tops of shelves as follows:
 - a. Basis-of-Design (BOD) Product: Thermally Fused Laminate (TFL) as manufactured by Wilsonart LLC, color White, finish Matte, Product code 1570-60, or approved equal.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content:

- a. Non-Climate-Controlled Environments: 9 to 15 percent.
- b. Climate-Controlled Environments: 6 to 10 percent.

- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in CARB 93120, "Airborne Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
 - a. Hardwood Plywood: 0.05 ppm.
 - b. Particleboard: 0.09 ppm.
 - c. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.
 - d. MDF 5/16 Inch (8 mm) or Less in Thickness: 0.13 ppm.
3. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
4. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
5. Softwood Plywood: DOC PS 1, medium-density overlay .
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
7. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper.

2.4 NON-WOOD SURFACE MATERIALS

- A. Basis-of-Design (BOD) Products: Subject to compliance with the requirements, provide the following at locations as indicated:

1. All tack surfaces:

- a. Basis of Design Product: Subject to compliance with requirements, provide Forbo, Bulletin Board Pinboard Linoleum, color 2162 "duck egg", to be confirmed by architect through submittal review.

2. All writable surfaces:

- a. Basis of Design Product: Subject to compliance with requirements, provide Koroseal, Walltalkers JR48-00 Just-Rite, color "white", or approved equal to be confirmed by architect through submittal review.

2.5 UPHOLSTERY

- A. Basis-of-Design (BOD) Products: Subject to compliance with the requirements, provide the following at locations as indicated:

- 1. Upholstery:

- a. Seats:

- 1) Padding material: Natural latex, firm cushion
 - 2) Padding thickness: 2"
 - 3) **Fabric Basis of Design: Designtex, Ethos, color 8060 "patina"**, to be confirmed by architect through submittal review.
 - 4) Options: Provide 4/32 fiber cord trim.

- b. Backs:

- 1) Padding material: Natural latex, firm cushion
 - 2) Padding thickness: 1" minimum.
 - 3) **Fabric Basis of Design: Designtex, Ethos, color 8060 "patina"**, to be confirmed by architect through submittal review.
 - 4) Options: Provide 4/32 fiber cord trim.

- c. Panel:

- 1) Padding material: Natural latex, firm cushion
 - 2) Padding thickness: 1".
 - 3) **Fabric Basis of Design: Designtex, Ethos, color 8060 "patina"**, to be confirmed by architect through submittal review.

2.6 CASEWORK HARDWARE

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Basis-of-Design (BOD) Products: Subject to compliance with the requirements, provide the following at locations as indicated:

- 1. Hinges:

- a. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 160-180 degrees of opening, self-closing, with integral soft-close damper.
 - b. **BOD Hold Open Pivot Hinge: McKinney H8007**, or approved equal to be confirmed by architect through submittal review.

- 2. Pulls and Knobs:

- a. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

- b. **BOD Door and Drawer Pulls: Emtek, wire pull, 86133 4" center-to-center, satin nickel finish**, or approved equal to be confirmed by architect through submittal review.
- 3. Catches and Latches:
 - a. Magnetic Catches: ANSI/BHMA A156.9, B03141.
- 4. Locks:
 - a. Cam Locks and Push Locks: ANSI/BHMA A156.11
 - b. **BOD Cabinet and Drawer Locks: Sugatsune Cabinet Lock 2100**, or approved equal to be confirmed by architect through submittal review.
 - c. **BOD Sliding Panel Locks: Sugatsune Push Lock 2160M**, or approved equal to be confirmed by architect through submittal review.
 - d. Provide lockable cabinets, drawers, and sliding panels where applicable on the Entry Level, Community Room 014, and Children's Lunch Room 003.
- 5. Shelf Rests and Standards:
 - a. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
 - b. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- 6. Drawer Slides: ANSI/BHMA A156.9.
 - a. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - b. Type: Full overtravel extension.
 - c. Material: Epoxy-coated polymer slides.
 - d. Motion Feature: self-closing mechanism.
- 7. Sliding Panel Hardware:
 - a. **BOD Rollers: Sugatsune Sliding Door Rollers, FES-0339**, or approved equal to be confirmed by architect through submittal review.
 - b. **BOD Rail: Sugatsune "V" Rail for Sliding Doors, AVF-12S/1820**, or approved equal to be confirmed by architect through submittal review.
- 8. Reveals:
 - a. **BOD Reveal: Fry Reglet. Millwork U Channel, 3/4"**, or approved equal to be confirmed by architect through submittal review.
- 9. Door Bumpers: Manufacturer's standard self-adhering clear silicone pads.
- 10. IT Equipment Management Hardware:
 - a. **BOD Undercounter Wire Trays: Undercounter Management Tray and Cord Raceway, Item # 9SIBZZPKPM4483; coordinate length with cabinet interior**, or approved equal to be confirmed by architect through submittal review.
 - 1) < <https://www.newegg.com/p/0ZK-0G4B-01C66>>
 - b. **BOD CPU Holder: CPU Under Desk Mount Bracket, 360 Degree Swivel, Adjustable Height and Width, Item # 9SIC0A0KFE9951**, or approved equal to

be confirmed by architect through submittal review.

- 1) < <https://www.newegg.com/p/169-01VH-00009>>

11. Grommets:

- a. **BOD Grommet: Mockett 12/C/M-94 – 12-19/32” Rectangular Max Grommet**, or approved equal to be confirmed by architect through submittal review.

- 1) < <https://www.mockett.com/max12-c-m-94.html>>

C. Hardware Finish:

1. Exposed Hardware: Provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - a. Satin Nickel (US15).
2. Concealed Hardware: Manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.7 ALUMINUM RACK SYSTEM

- A. Basis-of-Design (BOD) Products: Subject to compliance with the requirements, provide the following at locations as indicated:

1. **Basis of Design: Rakks, Rangine Corporation; Wall Mounted Shelving System.**

- a. Furnish components as required for a complete installation as indicated on Drawings.
- b. Finish: Satin Silver.
- c. Shelf Material: Rakks Aluminum.
- d. Shelf Depth: 12 inches.
- e. Wall Track Profile: E.
- f. Bracket Style: Rakks Style.
- g. Coordinate installation with framing and gypsum wallboard.
- h. Coordinate installation with locker furniture.

2.8 COUNTERTOPS

- A. Basis-of-Design Products: Subject to compliance with the requirements, provide the following countertops at locations as indicated:

1. All Countertops:

- a. **Basis of Design: Engineer Quartz product by Wilsonart or approved equal, color Q4061 “Hekla Slope”, 3cm thickness**, to be confirmed by architect through submittal review.

- 1) Ease exposed edges 1/16 inch.

- b. **Basis of Design: Aluminum Support Brackets: Rakks, Rangine Corporation**

EH Countertop Support Bracket.

- 1) Furnish in sizes and quantities as required to support associated countertop.
- 2) Mill finish.

LED STRIP LIGHTING

- B. Refer to section 265100 – Interior Lighting for requirements.

2.9 PERIODICAL DISPLAY

- A. Provide a slatwall fabricated from MDF, with a hardwood frame, as indicated on the drawings.

1. Hardware:

- a. Provide aluminum groove inserts, stagger seams between rows.
- b. Periodical display inserts:

- 1) **Basis of design: 3branch Product Design Solutions, magbox slatwall – newspaper.** Provide twelve (12).
- 2) **Basis of design: 3branch Product Design Solutions, magbox slatwall – standard.** Provide sixteen (16).

2. Finish: Refer to Section 099123 – Interior Painting and as indicated on the drawings.

2.10 FABRICATION

- A. Fabricate countertops to largest dimension of material as possible to minimize seams. Verify location of seams in field with Architect prior to fabrication.
- B. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease sharp edges and corners.
- C. 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.
- D. 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.

2.11 SHOP FINISHING

- A. Finish architectural cabinets at manufacturer's 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

architectural cabinets, as applicable to each unit of work.

C. Transparent Finish:

1. Aesthetic Performance Grade: Premium.
2. Finish System: TR-11, polyurethane, water-based.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
4. Staining: None required.
5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.
1. Confirm location and adequacy of blocking and supports required for installation.
 2. Verify size and locations of cutouts for appliances, special equipment, sinks, plumbing, and other items to be mounted in or adjacent to casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.3 INSTALLATION OF CASEWORK

- A. Install casework to comply with requirements of the structural and aesthetic performance specified.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 3. Maintain veneer sequence matching of cabinets with transparent finish.
- D. Anchor cabinets in accordance with AWI requirements or tested method to anchors or blocking built in or directly attached to framing or substrates.

- E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.
 - a. Use filler matching finish of items being installed.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where impossible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware and other moving parts to function smoothly.
- C. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

END OF SECTION 064100

SECTION 071416

COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-component polymer-modified waterproofing.
2. Molded-sheet drainage panels.

1.2 REFERENCES

- A. ASTM D146-97 - Standard Test Methods for Sampling and Testing Bitumen- Saturated Felts and Fabrics Used in Roofing and Waterproofing.
- B. ASTM D412-98a(2002)e1 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- C. ASTM E96-00e1 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.
- D. ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For the following products:
 1. Flashing sheet, 10 by 8 inches (250 by 200 mm).
 2. Membrane-reinforcing fabric, 10 by 8 inches (250 by 200 mm).
 3. Drainage panel, 4 by 4 inches (100 by 100 mm).
- D. Qualification Data: For Installer.
- E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- F. Warranty: Sample of special warranty.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials, protection course and molded-sheet drainage panels from single source from single manufacturer.

C. 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 flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, 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 waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight and prevent damage or contamination.
- E. Ensure concrete has been cured for a minimum on 14-days prior to application.

1.7 PROJECT 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, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
 1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
 - a. Do not apply membrane if rainfall is forecast or imminent within two hours.
 2. Do not apply to frozen concrete.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.
- C. For spray applications, ensure material has been stored at room temperature or heated to a minimum of 50° F (10° C) prior to application.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch (1.6 mm) in width.
 2. Warranty Period: Five years from date of Final Completion.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYMER-MODIFIED WATERPROOFING

- A. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.
 - 1. Basis of Design: Subject to compliance with requirements, provide Carlisle Coatings & Waterproofing Inc; CCW MiraSEAL or a comparable product by one of the following:
 - a. Tremco TREMproof 250 GC.
 - b. GCP Applied Technologies Inc. (formerly Grace Construction Products) Procor.
- B. Compatible self-adhering sheet membrane (consisting of 56 mils of rubberized asphalt laminated to 4 mils of polyethylene to form 60 mil membrane) to be used in conjunction with MiraSEAL at below grade expansion joints. Field fabricate into an inverted strip. Basis of design: Carlisle Coatings & Waterproofing Inc; CCW MiraDRI 860/861.

2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.
- B. Primer: Not required for concrete.
- C. Concrete Repair Materials:
 - 1. Meadow-patch 5 and 20 concrete repair mortars by WR Meadows
 - 2. Or approved equal.
- D. Sheet Flashing: Manufacturer's recommended contact adhesive.
- E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- F. Joint Sealant: CCW-201 polyurethane sealant
 - 1. Backer Rod: Closed-cell polyethylene foam.

2.3 PROTECTION COURSE

- A. Protection Course:
 - 1. Basis of Design: Subject to compliance with requirements, provide Carlisle Coatings & Waterproofing Inc; CCW Protection Board-V or a comparable product by one of the following:
 - a. Tremco
 - b. GCP Applied Technologies Inc. (formerly Grace Construction Products)
 - 2. Verify acceptability of type of protection course with waterproofing manufacturer.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings & Waterproofing Inc; CCW MiraDRAIN 6200 or a comparable product by one of the following:
 - a. American Hydrotech, Inc.
 - b. BASF Corp. - Construction Chemicals.
 - c. GCP Applied Technologies Inc. (formerly Grace Construction Products).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or 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.
 - 1. Concrete surfaces must be clean, relatively smooth and free of standing water.
- D. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
 - 1. Patch all holes and voids and smooth out any surface misalignments.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prime substrate unless otherwise instructed by waterproofing manufacturer.

- B. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
 - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
 - 1. Apply bond breaker between sealant and preparation strip.
 - 2. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches (75 mm) along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.
 - 1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.5 WATERPROOFING APPLICATION

- A. Start installing waterproofing in presence of manufacturer's technical representative.
- B. Apply primer over prepared substrate.
- C. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils (1.5 mm) and a minimum dry film thickness of 50 mils (1.3 mm) at any point.
 - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.

3.6 CURING, PROTECTION, AND CLEANING

- A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
 - 1. 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 071416

SECTION 072119
OPEN-CELL SPRAY FOAM INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Open-cell spray polyurethane foam insulation.

1.2 RELATED WORK

- A. The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 20 00 - UNIT MASONRY
2. Section 06 10 00 - ROUGH CARPENTRY
3. Section 07 92 00 - JOINT SEALANTS

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for flame and smoke, concealment, and over coat requirements.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the relat-

ed credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
- b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
- c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
- d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing urethane foam products and systems of this section with minimum ten years documented experience.
- B. Installer Qualifications: A current installer specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- C. Store products in manufacturer's unopened packaging, clearly marked with the manufacturer's name, brand name, product identification, type of material, safety information, manufacture date, and lot numbers until ready for installation.

- D. Store spray foam materials between 65 degrees F (18 degrees C) and 85 degrees F (29 degrees C) with careful handling to prevent damage to products.
- E. Protect all materials from freezing and other damage during transit, handling, storage, and installation.

1.9 PROJECT CONDITIONS

- F. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- G. Do not apply the polyurethane foam when substrate or ambient air temperatures are below 40 degrees F (4.4 degrees C) or above 120 degrees F (49 degrees C) and relative humidity is greater than 85 percent unless advance means and methods are recommended by the manufacturer.
- H. Do not apply polyurethane foam when wind velocity exceeds 15 miles per hour unless advance means and methods are recommended by the manufacturer. Use precautions to prevent damage to adjacent areas from fugitive overspray.

PART 2 - PRODUCTS

2.1 OPEN-CELL SPRAY FOAM INSULATION

- A. Basis-of-Design: JM Open Cell Spray Foam (JM OCSPF) by Johns Manville
- B. Open Cell Spray Foam Insulation: Two-component, polyurethane cellular foam with a nominal density of 0.5 pcf, as manufactured by Johns Manville. JM OCSPF foam shall have the following minimum physical properties when cured:
 - 1. Apparent Density: 0.5 pcf when tested in accordance with ASTM D 1622.
 - 2. R-Value (aged) when tested in accordance with ASTM C 518: 3.9 at 1 inch, 13 at 3.5 inches, 19 at 5.5 inches.
 - 3. Oxygen Index: 25 when tested in accordance with ASTM D 2863.
 - 4. Compressive Strength: 0.5 psi when tested in accordance with ASTM D 1621.
 - 5. Fungi Resistance: Zero Rating when tested in accordance with ASTM G 21.
 - 6. Air Leakage: Less than 0.02 (L/s)/m2 when tested in accordance with ASTM E 283.
 - 7. Sound Transmission Coefficient: 51 (STC) when tested in accordance with ASTM E 90.
 - 8. Noise Reduction Coefficient: 0.7 (NRC) when tested in accordance with ASTM C 423.

9. Open Cell Content: Greater than 90 percent when tested in accordance with ASTM D 2846.
 10. Tensile Strength: Less than 5 psi when tested in accordance with ASTM D 1623.
 11. Shear Strength: 1.4 psi when tested in accordance with ASTM C 273.
 12. Permeability: 21 perm-inch when tested in accordance with ASTM E 96.
 13. Dimensional Stability: Less than 15 percent change in volume when tested in accordance with ASTM D 2126.
 14. Surface Burning Characteristics:
 - a. Flame Spread/Smoke Developed: At maximum 4 inch (102 mm) thickness, flame spread index of less than 25 and a smoke developed index of less than 450 when tested in accordance with ASTM E 84.
 - b. Corner Test: Thickness up to 12 inches (305 mm) for wall cavities and 16 inches for ceiling cavities meets NFPA 286 when covered with 1/2 inch (13 mm) gypsum board or equivalent thermal barrier.
- C. Primer as Applicable to Substrate: A water based epoxy primer to achieve superior adhesion and penetration on concrete, masonry, metal, wood, etc. as supplied by Johns Manville or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that all surfaces to receive polyurethane foam insulation are clean, dry and free of dust, dirt, debris, oil, solvents and all materials that may adversely affect the adhesion of the polyurethane foam.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Mask and protect adjacent surfaces from over spray.

C. Prepare surfaces using the methods recommended by the spray foam manufacturer for achieving the best result for the substrate under the project conditions.

D. Wood:

1. Plywood shall contain no more than 18 percent water, as measured in accordance with ASTM D 4449 and ASTM D 4444.
2. Most untreated and unpainted wood surfaces need not be primed. The spray polyurethane foam can be applied directly to the dry wood. Priming may be required under certain conditions as recommended by the manufacturer.

E. Steel:

1. Primed: Clean primed metal surfaces free of loose scale, rust, weathered or chalking paint. Remove grease, oil, or other contaminants with proper cleaning solutions.
2. Previously Painted: Clean painted metal surface using hand or power tools to remove loose scale and dirt. Remove grease, oil, and other surface contaminants using a power wash technique or proper cleaning solutions.
3. Galvanized: Clean galvanized steel as recommended by manufacturer. Steel should be primed with primer at the rate of 1 gallon per 300 square feet.
4. Unpainted Steel: Clean as recommended by manufacturer to prepare the steel surface for the primer. Prime with primer at the rate of 1 gallon per 300 square feet.

F. Concrete and Masonry: Must be cured and loose dirt and any other contaminants, including asphaltic materials removed. If primer is required, prime at the rate of one gallon per 300 square feet.

G. Sheathing Board: Most sheathing boards need not be primed prior to the application of sprayed-in-place polyurethane foam.

3.3 PRIMER APPLICATION

A. Prepare surfaces and apply primer in accordance with manufacturer's instructions.

B. Apply primer to the properly prepared substrates in accordance with the manufacturer's instructions to achieve a minimum thickness of dry film thickness. Allow primer to cure 24 hours prior to application of spray polyurethane foam or other products.

3.4 INSTALLATION

A. Install in spray foam in accordance with manufacturer's instructions.

- B. Spray polyurethane foam components (A) and (B) shall be processed in accordance with instructions found on the manufacturers product datasheet.
- C. Schedule application to anticipate climatic conditions prior to application to ensure highest quality foam and to maximize yield. All substrates to be sprayed must be dry at the time of application. Moisture in the form of rain, fog, frost, dew, or high humidity greater than 85 percent R.H is not permitted unless Contractor reviews means and methods of spraying with manufacturer's representative prior to installation. Use screens, masking and other precautions to prevent damage to adjacent areas from fugitive overspray.
- D. One-hour Fire-Resistance Rated Wall Assemblies (Limited Load Bearing):
1. Interior Face: One layer of 5/8-inch-thick (15.9 mm) Type X gypsum wallboard must be applied parallel to the interior face of 2-by-6 wood studs space a maximum of 16 inches (406 mm) on center and fastened with Type S, 1-5/8 inch (41 mm) long screws spaced 8 inches (203 mm) on center. The interior cavity is filled with 3 inches of JM ocSPF spray-applied foam insulation.
 2. Exterior or Opposite Face: Another layer of 5/8 inch (15.9 mm) thick Type X gypsum wallboard must be applied in the same manner as the interior face.
 3. Axial Load Design: Axial loads applied to the wall assembly must be limited to the least of the following:
 - a. 2,756 pounds (122 642 N) per stud.
 - b. A maximum of 51 percent of the load calculated in accordance with Sections 3.6 and 3.7 of the ANSI/AF&PA NDS.
- E. Exothermic Caution:
1. Polyurethane foam shall be sprayed in minimum 1/2 inch (12.7 mm) thick passes or lifts. Overall thickness applied in one pass shall be limited to a maximum of 6 inches for JM ocSPF open cell foam to avoid fire hazards resulting from excessive heat generation. When applying SPF on chlorinated polyvinyl chloride the pass thickness for JM ocSPF must be limited to 6 inches. If additional thickness is required it must applied within 15 minutes.
 2. If a second pass is needed, wait 10 to 15 minutes between passes to allow reaction heat to dissipate. If more passes are needed, wait 30 minutes between passes to allow reaction heat to dissipate.
 3. The exothermic reaction can cause temporary substrate thermal rises in excess of 150 degrees F, which may result in substrate thermal expansion. If the substrate then contracts when the reaction heat dissipates, substrate deformation can occur.
 4. The full thickness of spray polyurethane foam to be applied within any given area should be completed in one day.

F. Vapor Retarder Application:

1. When required, a vapor retarder shall be applied to the substrate to be insulated or to the finished spray polyurethane foam insulation. The predominant direction of the vapor drive determines the location of the vapor retarder relative to the spray polyurethane foam.
2. Apply thermal barriers and vapor retarder (if required) according to ICC recommendations.

3.5 ACCESSORY APPLICATION

- A. Joint Filler Foam and Caulk: Use joint filler foam and/or caulk to seal around windows, doors, chimneys, electrical raceways, sill plates, multiple studs, etc. Expansion of joint filler foam in a confined space can tighten window frames and door jambs. Use care in these areas to avoid distortion of these members.
- B. Vapor retarders are specified in Section 072600.
- C. Air barriers are specified in Section 072700.

3.6 FIELD QUALITY CONTROL

- A. Protect installed products until completion of project.
- B. Field inspection and testing will be performed under provisions of Section 01 40 00. Inspection will include verification of insulation and overcoat thickness and density.

3.7 PROTECTION

- A. Protect installed products until completion of project.
- B. After completing work, clean glass and spattered surfaces.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 072119

SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Penetration firestopping systems.
 - 1. Penetration firestopping systems in fire-resistance-rated walls.
 - 2. Penetration firestopping systems in horizontal assemblies.
 - 3. Exposed penetration firestopping systems.
- B. Related Requirements:
 - 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
 - 2. Section 079200 "Joint Sealants" for non-fire-resistance-rated joint sealants.
 - 3. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
- C. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.

3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping systems when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

- B. Install and cure penetration firestopping system materials in accordance with manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be accessed and installed in accordance with specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain penetration firestopping systems for each type of opening indicated from single manufacturer.

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following :

1. **3M Building and Construction**
2. **FireShield; Fire Rated Solutions LLC**
3. **Hilti, Inc.**
4. **Tremco Incorporated**

- B. Penetration firestopping systems must be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Penetration firestopping systems must be installed with products bearing the classification marking of a qualified testing agency.
 - a. UL Solutions in its online directory "Product iQ."
 - b. Intertek Group in its "Directory of Building Products."
 - c. FM Approvals in its "Approval Guide."
2. Provide components for each penetration firestopping system that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.
3. Provide components for each penetration firestopping system that do not contain ethylene glycol.
4. Provide components for each penetration firestopping system that are sufficiently flexible to accommodate movement, such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage.

5. Provide components for each penetration firestopping system that are appropriately tested for the thickness and type of insulation utilized.
- C. Provide penetration firestopping systems that resist spread of fire, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- D. Penetration Firestopping Systems in Fire-Resistance-Rated Walls: Systems with ratings determined in accordance with ASTM E814 or UL 1479.
 1. F-Rating: Not less than the fire-resistance rating of the wall assembly penetrated.
 2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.
- E. Penetration Firestopping Systems in Horizontal Assemblies: Systems with ratings determined in accordance with ASTM E814 or UL 1479.
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor/ceiling assembly penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor/ceiling assembly. The following horizontal penetrations do not require a T-rating:
 - a. Those within the cavity of a wall.
 - b. Floor, tub, or shower drains within a concealed space.
 - c. 4-inch or smaller metal conduit penetrating directly into metal-enclosed electrical switchgear.
- F. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84 or UL 723.

2.3 ACCESSORIES

- A. Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated, including but not limited to:
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.4 FILL MATERIALS

- A. Cast-in-Place Firestopping Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with

intumescent material sized to fit specific diameter of penetrant.

- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, and when required by a listed system, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed or dislodged.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- K. Thermal and Endothermic Wraps: Flexible, insulating, and fire-resistant protective wraps tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479; for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines, and for thermal barrier and circuit integrity protection in accordance with ASTM E1725 or UL 1724.
- L. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls which accept standard accessories.
- M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.
 - 1. Fire-rated cable pathway devices are the preferred product for data, video, and communications cable penetrations. Install these devices in locations where frequent cable moves, add-ons, and changes will occur. Such devices must be:
 - a. Capable of retrofit around existing cables.
 - b. Designed so that two or more devices can be ganged together.
 - c. Maintenance-free so no action is required to activate the smoke- and fire-sealing mechanism.
 - 2. Where fire-rated cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video, and communications cabling must be provided with re-enterable products specifically designed for retrofit, such as retrofit devices for cable bundles, firestopping putty, plugs, or pillows.
- N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping

existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.

- O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.
- P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestopping gasket for use around rectangular steel HVAC ducts without fire dampers.
- Q. Firestopping Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.
- R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch in diameter.
- S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

2.5 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings in accordance with manufacturer's written instructions and with the following requirements:
 - 1. Remove foreign materials from substrate surfaces that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates in accordance with penetration firestopping system manufacturer's written

installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

- A. General: Install penetration firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078443
JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated construction.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers .
2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

C. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.

3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written installation instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL and found to comply with UL's "UL Solutions Qualified Firestop Contractor Program."

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems in accordance with manufacturer's written installation instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed in accordance with specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. A qualified testing agency, acceptable to authorities having jurisdiction, will perform joint firestopping system tests.
 - 2. Test in accordance with testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
- B. Rain/Water Resistance: For perimeter fire-barrier system applications, where inclement weather or greater-than-transient water exposure is expected, use products that dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain-resistance test (24-hour exposure).

2.3 JOINT FIRESTOPPING SYSTEM TYPES

- A. General: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing

their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
 2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
 3. Provide firestop products that do not contain ethylene glycol.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined in accordance with ASTM E1966 or UL 2079, with published L-Ratings for ambient and elevated temperatures as evidence of the ability of the fire-resistive joint system to restrict the movement of smoke.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following :
 - a. **3M Building and Construction**
 - b. **ClarkDietrich**
 - c. **Hilti, Inc.**
 - d. **Owens Corning**
 - e. **ROCKWOOL**
 - f. **Tremco Incorporated**
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined in accordance with ASTM E84.
1. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 ACCESSORIES

- A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints in accordance with fire-resistive joint system manufacturer's written installation instructions and the following requirements:
 - 1. Remove foreign materials from substrate surfaces that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates in accordance with joint firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Apply a suitable bond breaker to prevent three-sided adhesion in applications where condition occurs.

3.3 INSTALLATION

- A. General: Install joint firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Apply elastomeric fill in voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..

3.5 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION 078443

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.
6. Joint sealant backing materials including cylindrical sealant backing and secondary seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:

1. Product Data: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.

3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. VOC Content: Sealants and sealant primers shall comply with the following:
 - 1. Architectural sealants shall have a VOC content of 250 g/L or less.
 - 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
 - 3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.
 - 4. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's standard range.

2.2 SILICONE JOINT SEALANTS

- A. Mildew-Resistant Neutral-Curing Silicone Joint Sealant ASTM C 920.
 - 1. Products: Subject to compliance with requirements, provide product by one of the following:
 - a. **BASF Building Systems.**
 - b. **Dow Corning Corporation.**
 - c. **GE Advanced Materials - Silicones.**
 - d. **Pecora Corporation.**
 - e. **Sika Corporation; Construction Products Division.**
 - f. **Tremco Incorporated.**
 - 2. Type: Single component (S) or multicomponent (M).

3. Grade: Nonsag NS).
4. Class: 100/50
5. Uses Related to Exposure: Nontraffic (NT).

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- 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, low modulus; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **Pecora Corporation; 890NST.**
 - b. **Dow Corning, 790.**
 - c. **Tremco Incorporated; Spectrum 1.**

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **Pecora Corporation; Dynatrol I-XL.**
 - b. **Sika Corporation; Sikaflex 1A.**
 - c. **Tremco Incorporated; Dymonic.**
- B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **BASF Corporation-Construction Systems; MasterSeal SL1.**
 - b. **Pecora Corporation; NR-201.**
 - c. **Polymeric Systems, Inc; Flexiprene 952.**
 - d. **Tremco Incorporated; Vulkan 455SL.**
- C. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. **Pecora Corporation; Dynatrol II.**
 - b. **Sika Corporation: Sikaflex 2C**
 - c. **Tremco Incorporated; Dymeric 240.**

- D. Urethane, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, UV stable, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses NT.

1. Products: Subject to compliance with requirements, provide the following:

- a. **Pecora Corporation; Dynatrol I-XL.**
- b. **Sika Corporation: Sikaflex 15LM.**
- c. **Tremco Incorporated; Dymonic 100.**

- E. Urethane, M, P, 25, T: Multicomponent, plus 25 percent and minus 25 percent movement capability, traffic-, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T, A, and M.

1. Products: Subject to compliance with requirements, provide the following:

- a. **BASF Corporation-Construction Systems; Masterseal SL2.**
- b. **Sika Corporation; Sikaflex 2C-SL.**
- c. **Tremco Incorporated; THC-901.**

2.5 PREFORMED JOINT SEALANTS

- A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit varying joint widths as required; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Products: Basis-of-Design: Backerseal by EMSEAL Joint Systems, Ltd. Subject to compliance with requirements, provide product by one of the following:

- a. **Dayton Superior Specialty Chemicals.**
- b. **Sandell Manufacturing Co.**
- c. **Schul International, Inc.**
- d. **Willseal USA, LLC.**

2.6 MILDEW-RESISTANT SILICONE 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 C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide the following:

- a. **Dow Corning Corporation; 786 Silicone Sealant.**
- b. **Pecora Corporation: 898NST.**
- c. **Tremco Incorporated; Tremsil 200.**

2.7 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **BASF Construction Chemicals, LLC, Building Systems; Sonolac.**
 - b. **May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600 or Bondaflex Sil-A 700.**
 - c. **Pecora Corporation; AC-20.**
 - d. **Sherwin-Williams Company (The); 850A or 950A.**
 - e. **Tremco Incorporated; Tremflex 834.**
- B. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. **Bostik, Inc.; Chem-Calk 300.**
 - b. **Pecora Corporation; BC-158.**
 - c. **Tremco Incorporated; Tremco Butyl Sealant.**

2.8 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Secondary Seal to Field-Applied Sealants in Above Grade Vertical Walls and where indicated on drawings:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide **Backerseal; EMSEAL Joint Systems, Led.**; (800) 526-8365; www.emseal.com; or an equal product by another manufacturer.
 - 2. Description: 100% acrylic impregnated expanding foam sealant with internal laminations of closed cell foam.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - c. Other joints as indicated on Drawings.
 1. Urethane Joint Sealant: Single component, pourable, traffic grade.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- B. Joint-Sealant Application: Exterior joints in horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Roof copings, flashing and counterflashing.
 - b. Other joints as indicated on Drawings.
 2. Urethane Joint Sealant: Single component, nonsag, NT, Class 100/50
 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, nonstaining, nonsag, Class 50.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 1. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 50.
 2. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.

- b. Perimeter joints of exterior openings where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, single component, nonsag, Class 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
- 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors. Paintable.
- G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, single component, nonsag, Class 25, neutral curing.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.
- H. Joint-Sealant Application: Concealed mastics.
- 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's standard range of colors.

END OF SECTION 079200

SECTION 079219

ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product:
 - 1. Interior: New STC-rated wall assemblies
 - 2. Interior: New ceiling assemblies
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.
- C. Samples for Verification: For each type and color of acoustical joint sealant required.
 - 1. Size: 1/2-inch- wide sealant joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Acoustical Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- E. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each type of acoustical joint sealant, for tests performed by qualified testing agency .

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

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 between 40 and 95 deg F.

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 coatings only when temperature of surfaces to be coated and ambient air temperatures are between 35 and 100 deg F.

1.8 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.

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.

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following :

- a. **DAP Products Inc.**
- b. **Hilti, Inc.**
- c. **OSI Sealants; Henkel Corporation**
- d. **Specified Technologies Inc.**
- e. **USG Corporation**

2. Colors of Exposed Acoustical Joint Sealants: Clear

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. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Masonry".
3. Division 06 Section "Rough Carpentry".
4. Division 06 Section "Finish Carpentry".
5. Division 08 Section "Operations and Maintenance".
6. Division 08 Section "Stainless Steel Doors and Frames".
7. Division 08 Section "Flush Wood Doors".
8. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
9. Division 08 Section "Glazing".
10. Division 08 Section "Door Hardware".
11. Division 09 Sections "Interior Painting".
12. Division 26 Section "Electrical"

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.

10. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
11. ASTM C1199 - Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
12. ASTM E1423 - Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
13. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
14. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
15. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
16. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
17. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
19. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 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 anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment

required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.

2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.

2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Pioneer Industries (PI).
4. De la Fontaine Industries (DLFI)

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. A60 galvanized steel, 18-gauge. Aluminum Moldings. (DLFI)
 1. Fire resistance approval: Positive pressure UL 10C
 2. Conforms to the American National Standards Institute ANSI A250.4 standard
 3. Includes materials with high recycled content
- D. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Custom Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 1. Basis of Design: De La Fontaine Industries Recessed Panel with Profiled Molding.
 2. Core Construction: Honeycomb Core (required for factory finish)
 3. Level/Model: C. A60 galvanized steel, 18-gauge. Aluminum Moldings. Pre-finishing in factory: Custom color to match dark brown/olive green exterior accents.
 4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 7. Panel Configuration: As shown on Drawings.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
7. Manufacturers Basis of Design:
 - a. Curries Company (CU) - Polystyrene Core - 707 Series.
 - b. Curries Company (CU) - QMax Core - 707 Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.
- C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
 3. Manufacturers Basis of Design:
 - a. Curries Company (CU) - Mercury 3 Thermal Break TQ Series.
- D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 3. Manufacturers Basis of Design:
 - a. CECO Door Products (C) - BU Series.
 - b. Curries Company (CU) - C CM Series.
 - c. Curries Company (CU) - M Series.
- E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

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

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

- b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 - 10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 - 11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
- 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
- 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

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

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 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.

END OF SECTION 081113

SECTION 081119

STAINLESS STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Stainless steel doors and frames.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for Mortar: Grout fill of metal frames.
2. Section 079200 "Joint Sealants" for Sealing of joints between masonry and frames. Sealing of glazing.
3. Section 081113 "Hollow Metal Doors and Frames" for hollow-metal doors and frames manufactured from steel.
4. Section 087100 "Door Hardware" for door hardware for stainless steel doors.

1.2 REFERENCES

A. Standards Agencies:

ANSI	American National Standards Institute, Inc., 1430 Broadway Avenue, New York, New York 10018.
ASTM	American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428.
NAAMM	National Association of Architectural Metal Manufacturers, 600 South Federal Street, Chicago, Illinois 60605.
NFPA	National Fire Protection Association 1 Batterymarch Park P.O. Box 9101 Quincy, MA 02269
UL	Underwriters Laboratory, 333 Pfingsten Road, Northbrook, Illinois 60062.

B. Standards:

1. ANSI A250.4-2011, Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Hardware Reinforcings
2. ANSI/NAAMM HMMA 801-12, Glossary of Terms for Hollow Metal Doors and Frames
3. ANSI/NFPA 80 -2015, 16th Edition, Standard for Fire Doors and Fire Windows
4. ANSI/NFPA 252-2017, Standard Methods of Fire Tests of Door Assemblies
5. ANSI/UL 10B-2009, Fire Tests of Door Assemblies, 9th edition
6. ANSI/UL 10C-2016, Positive Pressure Fire Test of Door Assemblies, 1st Edition
7. ASTM B117-16 Method of Salt Spray (Fog) Testing.
8. ASTM C 143/C 143M-15a, Test Method for Slump of Hydraulic-Cement Concrete
9. ASTM D1735-14, Practice for Testing Water Resistance of Coating Using Water Fog Apparatus.
10. NAAMM HMMA 802-07, Manufacturing of Hollow Metal Doors and Frames
11. NAAMM HMMA 803-08, Steel Tables
12. NAAMM HMMA 810-08, Hollow Metal Doors
13. NAAMM HMMA 810 TN01-03, Defining Undercuts
14. NAAMM HMMA 820-87, Hollow Metal Frames
15. NAAMM HMMA 820 TN01-03, Grouting Hollow Metal Frames
16. NAAMM HMMA 820 TN02-03, Continuously Welded
17. NAAMM HMMA 830-02, Hardware Selection for Hollow Metal Doors and Frames
18. NAAMM HMMA 831-11, Recommended Hardware Locations for Hollow Metal Doors and Frames
19. ANSI/NAAMM HMMA 866 Commercial Stainless Steel Doors and Frames
20. NAAMM HMMA 840-16, Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames
21. NAAMM HMMA 850-14, Fire-Rated Hollow Metal Doors and Frames

1.3 DEFINITIONS

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

1.4 COORDINATION

- A. Coordinate anchorage installation for stainless steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 TESTING AND PERFORMANCE

- A. Performance Test for Steel Doors and Hardware Reinforcements (ANSI A151.1)
- B. The test specimen shall be a 3' - 0" x 7' - 0" nominal size 1³/₄" door.
- C. The specimen shall be tested in accordance with the ANSI A151.1 procedure for the Level "A" doors (1,000,000 cycles).
 - 1. The specimen shall be tested in accordance with the ANSI A151.1 procedure for twist test which requires a maximum pressure of 300 lbs. pressure.
- D. All test reports shall include a description of the test specimen, procedures used in testing, and indicate compliance with the acceptance criteria of the test.
- E. Labeled Fire-Rated Doors and Frame Product.
 - 1. Doors, frames, transom frames and sidelight assemblies provided for openings requiring fire, temperature rise, shall be listed and/or classified and bear the label of a testing agency having a factory inspection service. The product shall be tested in accordance with ANSI/NFPA 252 or ANSI/UL-10B, ANSI, UL-10C and constructed as listed or classified for labeling. Fire, temperature rise and/or smoke and draft control ratings shall be determined and scheduled by the Architect.
 - 2. If any door or frame product specified by the Architect to be fire-rated cannot qualify for labeling because of design, hardware or any other reason, the Architect shall be so advised in the submittal documents. If hardware, glazing, or other options affect the fire-rating and are unknown at the time of submittal document preparation, the architect shall be advised.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications.
 - 1. Manufacturer shall provide evidence of having personnel and plant equipment capable of fabricating stainless steel door and frame assemblies of the type specified herein.
- B. Installer Qualifications
 - 1. Installer, trained by the primary product manufacturer, with a minimum of five (5) years documented experience installing stainless steel doors and frame assemblies similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Quality Criteria.

1. Fire labeled doors and frames shall be provided for those openings requiring fire protection ratings as determined and scheduled by the Architect and as required by the applicable Building Code. Such doors and frames shall be constructed as tested in accordance with ASTM E152 (UL-I0B) and approved by Underwriters Laboratories or other recognized testing agencies having a factory inspection service.
2. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, hardware or any other reason, the Architect shall be so advised before fabricating work on that item is started.
3. Fabrication methods and product quality shall meet the standards set by the Hollow Metal Manufacturers Association, HMMA, a Division of the National Association of Architectural Manufacturers, NAAMM, as set forth in these specifications.

D, Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.1-2010
5. California Air Resources Board (CARB) 2007
6. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.7 ACTION SUBMITTALS

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

- C. Samples for Initial Selection: For stainless steel doors and frames.
1. Samples for Verification (No work to be fabricated until samples are approved):
 2. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
 3. Fabrication: Prepare Samples approximately 8 by 10 inches (203 by 254 mm) corner section to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge including welding joint of head to jamb, top, and bottom construction; core construction; and hinge, hinge mortise and other applied hardware reinforcement. Include separate section showing glazing if applicable with glazing stop applied to both head and jamb section to show corner joint.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing with stops if applicable.
- D. Product Schedule: For stainless steel doors and frames, show each door and opening, 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 – Show hardware group on schedule. Provide one schedule for the entire project – coordinate schedule for doors and openings of materials specified in other sections.

1.8 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.

4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver stainless steel doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 1. Provide additional protection to prevent damage to finished surface of stainless steel units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store stainless steel 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. Ceco Door; ASSA ABLOY.
 2. Curries Company; ASSA ABLOY.
 3. Greensteel Industries, Ltd.
 4. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.70 deg Btu/F x h x sq. ft. or as required to meet LEED Certification requirements when tested according to ASTM C 518.

2.3 STAINLESS STEEL DOORS AND FRAMES

- A. Stainless Steel Doors (Extra Heavy-Duty, SDI A250.8, Level 3) and Frames (Maximum Heavy-Duty, SDI A250.8, Level 4): NAAMM-HMMA 866; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.
 1. Doors for Highly Corrosive Environments:

- a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches. Doors shall be neat in appearance and free from warping or buckle. Edge bends shall be true and straight and of minimum radius for the thickness of the metal used.
 - c. Face: Face sheets shall be 0.050 in. (1.27 mm) minimum thickness and shall be manufactured from Type 316 stainless steel sheet. Steel shall be free of scale, pitting, coil breaks or surface blemishes, buckles, waves or other defects.
 - d. Edge Construction: Door face sheets shall be joined at their vertical edges by a continuous weld extending the full height of the door with no visible seams on their faces or vertical edges per HMMA-801-83. Joint shall be set toward the center of the vertical edge of the door. A joint at the corner of the door face and the vertical edge is not accepted. The top and bottom edges shall be closed with a continuous channel, also not less than 0.062" (1.59 mm) thickness, welded to both sheets.
 - e. Edge Profiles: Edge profiles shall be provided on both vertical edges of single acting doors as follows: beveled 1/8" in 1 3/4" profile. All hardware for single acting doors shall be designed for beveled edges as specified.
 - f. Core: The door shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.030" minimum thickness, spaced so that the vertical interior webs shall be no more than 6" apart and securely fastened to both face sheets by spot welds spaced a maximum of 5" o.c. vertically. Spaces between stiffeners shall be filled with fiberglass, batt-type material.
 - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 - h. Exposed Finish: No. 6, Dull Satin
2. Frames for Highly Corrosive Environments:
- a. Materials: Type 316 stainless steel sheet. Minimum thickness: In openings 4' - 0" or less, steel shall be 0.062" (1.59 mm) minimum thickness. In openings greater than 4' - 0", steel shall be 0.078" (1.98 mm) minimum thickness.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
 - 1) All frames shall have integral stops and be welded units of the sizes and types shown in the contract drawings.
 - 2) Corner joints shall have all contact edges closed tight with miter faces, and either butted or miter stops. Faces and soffits shall be continuously welded and the faces finished smooth. The use of gussets or splice plates as a substitute for welding shall not be acceptable.
 - 3) All other face joints shall be continuously welded and smoothly finished.
 - 4) Minimum depth of stops shall be 5/8". Cut-off stops, where shown, shall be capped at heights as shown in the contract drawings, and jamb joints below cut-off stops shall be welded, filled and ground smooth so that there are no visible seams
 - 5) When shipping limitations so dictate, frames for large openings shall be fabricated in sections designated for assembly in the field by others. Alignment plates or angles shall be installed at each joint. Such components shall be the same thickness as the frame. Field joints shall be made in accordance with approved submittal drawings and shall be field welded.
3. Exposed Finish: No. 6, Dull Satin.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type:

- a. Frames for installation in new masonry walls shall be provided with adjustable jamb anchors of the same material as the frame. Acceptable jamb anchors shall be TEE-strap or strap and stirrup type no less than 0.075" thickness, or wire type no less than 0.185" in diameter. Straps shall be no less than 2" x 10" in size, corrugated and/or perforated. All frames in new masonry shall be filled with grout. The number of anchors provided on each jamb shall be as follows:

- 1) Frames up to 60" ..., 2 anchors.
- 2) Frames greater than 60" up to 90" ..., 3 anchors.
- 3) Frames greater than 90" up to 96" ..., 4 anchors
- 4) Frames greater than 96", 4 anchors plus 1 for each 24" or fraction thereof over 96" spaced at 24" maximum between anchors (U.L. fire ratings may require additional anchors. Verify building and local code requirements, the most stringent will apply).

- b. Frames for installation in existing masonry or concrete walls shall be prepared for stainless steel expansion bolt type anchors. The preparation shall consist of a countersunk hole for a $\frac{3}{8}$ " diameter bolt and a spacer from the unexposed surface of the frame to the wall. The spacer shall be welded to the frame and spaced a maximum of 6" from the top and bottom, with intermediate spacing at a maximum of 26" o.c. Fasteners for such anchors shall be stainless steel provided by Installer. All frames installed in exterior openings shall be filled with grout.

2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).

3. Post-installed Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

1. Floor anchors with two holes for fasteners shall be fastened inside jambs with at least four (4) spot welded per anchor.
2. Where so scheduled for finish floor underlayment thickness, adjustable floor anchors, providing no less than 2" height adjustment, shall be fastened in place with at least four (4) spot welds per anchor. Terminate bottom of frames at top of underlayment.
3. Floor anchors shall be of the same material as the frame, with a minimum of 0.078" thickness.

C. Material: stainless steel sheet – same type as door face.

2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent

- B. Stainless Steel Sheet: ASTM A 240/A 240M, austenitic stainless-steel, Type 316.

- C. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, commercial steel, Type B.
- D. Metallic-Coated Steel Sheet: ASTM A653/A 653M, commercial steel, with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- E. Foam-Plastic Insulation: Manufacturer's standard polystyrene board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM 84. Enclose insulation completely within door.
- F. Mineral-Fiber Insulation: Insulation made of rock-wool fibers, slag-wool fibers, or glass fibers.
- G. Inserts, Bolts, and Fasteners: Stainless Steel where noted, otherwise, Hot-dip galvanized according to ASTM A 153/A 153M.
- H. 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.
- I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- J. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102) as measured according to ASTM C 143/C 143M.

2.6 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. Stainless Steel Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding
 - 2. Provide stainless steel countersunk sheet metal 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 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.
 - 4. Terminated Stops: Terminate stops [6 inches (152 mm)] <Insert dimension> above finish floor with a [45] [90]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
 - 5. Frames for installation in masonry wall openings more than 4' - 0" in width shall have an angle or channel stiffener made from the same material as the frame that shall be factory welded into the

head when the head is to be grouted. Such stiffener shall not be used as lintel or load bearing member, shall not be longer than the opening width but not shorter than 1" and they shall not be less than 0.105" in thickness.

6. Plaster guards shall be provided and welded in place at all hardware mortises on frames to be set in masonry or concrete openings. They shall be made from the same material as the frame with not less than 0.019" thickness.
 7. Where specified or scheduled, Stainless Steel Infill Panels will be secured flush to the outside of exterior frames or flush to the secure side of interior frames. The Infill Panels will be anchored to the frame sections with loose stops and moldings on inside or non-secure side of Stainless Steel frames. Provide stops for installation with stainless steel countersunk sheet metal screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Comply with BHMA A156.115 for preparing stainless steel doors and frames for hardware.
 2. Where nontemplated, mortised, and surface-mounted door hardware is to be applied, reinforce doors and frames, with all drilling and tapping done in the field, to receive:
 - a. Minimum thickness for hardware reinforcements in doors as follows:
 - 1) Full mortise hinges and pivots, 0.180".
 - 2) Reinforcements for lock fronts, concealed holders, or surface mounted closer, 0.105".
 - 3) Internal reinforcements for all other surface applied hardware 0.075".
 - b. Minimum thickness for hardware reinforcements in frames as follows:
 - 1) Hinge and pivot reinforcements ..., 0.195" x 1¼" >10" in length.
 - 2) Strike reinforcements ..., 0.105"
 - 3) Closer reinforcements ..., 0.105"
 - 4) Flush bolt reinforcements ..., 0.105"
 - 5) Reinforcements for surface applied hardware ..., 0.105"
 - 6) Reinforcements for hold open arms ..., 0.105"
 - 7) Reinforcements for surface panic devices ..., 0.105"
 3. In cases where electrically operated hardware is required, and indicated on architectural door schedule, conduit, hardware enclosures and/or junction boxes within the door shall be provided. Access plates where required shall be the same thickness as the door and fastened with a minimum of (4) #8-32 Stainless Steel machine screws or #6 Stainless Steel metal screws, not to exceed 12" o.c.

2.7 STAINLESS STEEL FINISHES

- A. Stainless Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Finish: No. 6, Dull Satin.
- C. Grain Direction: For finishes exhibiting grain, run grain vertically on door faces and frame jambs.

2.8 CLEARANCES AND TOLERANCES

- A. Edge clearances for swinging doors shall not exceed the following
1. Between doors and frames, at head and jambs ..., $\frac{3}{16}$ ".
 2. Between edges of pairs of doors ..., $\frac{1}{16}$ "
 3. At door sills where a threshold is used ..., $\frac{3}{8}$ ". Measured from bottom of door to top of threshold.
 4. At door sills where no threshold is used ..., $\frac{3}{4}$ ".
 5. Between door bottom and nominal surface of floor coverings at fire rated openings as provided in NFPA 80-990, Paragraph 2.5.5.
- B. Manufacturing tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 866; tolerances shall be maintained within the following limits:
1. Frames for single door or pair of doors:
 - a. Thickness of sheet metal ..., +0.015"; —0.007".
 - b. Width, measured between rabbets at the head. Nominal opening width ..., + $\frac{1}{16}$ "; — $\frac{1}{32}$ ".
 - c. Height (total length of jamb rabbet). Nominal opening height ..., + $\frac{3}{64}$ ".
 - d. Cross sectional profile dimensions.
 - 1) Face ..., + $\frac{1}{32}$ ".
 - 2) Stop ..., $\pm \frac{1}{32}$ ".
 - 3) Rabbet ..., + $\frac{1}{32}$ ".
 - 4) Depth ..., + $\frac{1}{32}$ ".
 - 5) Throat ..., $\pm \frac{1}{16}$ ". Frames overlapping walls to have throat dimension $\frac{1}{8}$ " greater than dimensioned wall thickness to accommodate irregularities in wall construction.
 2. Doors:
 - a. Thickness of sheet metal ... +0.015"; —0.007".
 - b. Width ..., + $\frac{3}{64}$ "
 - c. Height ..., + $\frac{3}{64}$ "
 - d. Thickness ..., + $\frac{1}{16}$ "
 - e. Hardware cutout dimensions. Template dimensions ..., +0.015"; —0"
 - f. Hardware location ..., + $\frac{1}{32}$ "

2.9 HARDWARE LOCATIONS

1. The location of hardware on doors and frames shall be coordinated with the locations indicated in Specification Section 087100 Door Hardware.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove wraps or covers from doors and frames upon delivery at the building site. Record any damage or error in the stainless steel doors and frames delivered to the job site, and notify the manufacturer/supplier on writing to maintain warranty and/or fire label

- B. Promptly clean and touch up any scratches or disfigurement caused in shipping or handling.
- C. 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. Check doors and frames for correct size, swing, fire rating and opening number.
- D. Store door and frame materials in a dry location on planks at least 4" off ground or 2" off floor slab. Doors shall be stored in a vertical position and spaced at least $\frac{3}{4}$ " by wood strip or blocking. Materials shall be covered to protect them from damage but in such a manner as to permit air circulation. Place no more than 5 doors or welded frames in a group. In the case of multi-opening frames, no more than three units should be stored in a group, to avoid serious racking or other damage to the bottom of the frame
- E. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install stainless steel doors and frames plumb, rigid, properly aligned, and braced securely until permanent anchors are set. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. The installer shall perform the following:
 - 1. Prior to installation, the area of floor on which the frame product is to be installed, and within the path of the door swing, shall be checked for flatness.
 - 2. Prior to installation, all interior surfaces of perimeter frame product sections to be installed in masonry or concrete walls shall be isolated and protected from grout and antifreeze agents.
- C. Doors and frame product shall be checked for correct size, swing, fire rating and opening number. Permissible installation tolerances shall not exceed the following:
 - 1. Squareness, $\pm 1/16$ " measured on a line, 90 degrees from one jamb, at the upper corner of the frame at the other jamb.
 - 2. Squareness, $\pm 1/16$ " measured on a line, 90 degrees from one jamb, at the upper corner of the frame at the other jamb.
 - 3. Twist, $\pm 1/16$ " measured at face corners of jambs on parallel lines perpendicular to the plane of the wall.
 - 4. Plumbness, $\pm 1/16$ " measured on the jamb at the floor.
- D. Stainless Steel Frames: Comply with NAAMM-HMMA 840.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.

3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 4. Hardware must be applied in accordance with hardware manufacturer's templates and instructions.
 5. Plaster guards and junction boxes are intended to protect hardware mortises and tapped mounting holes from masonry grout of 4" maximum slump consistency which is hand troweled in place. If a light consistency grout (greater than 5" slump when tested in accordance with ASTM C 143/C 143M) is to be used, special precautions must be taken in the field by the installation contractor to protect the aforementioned.
 6. Frame products are not intended or designed to act as forms for grout or concrete. Grouting of hollow metal sections shall be done in "lifts" or precautions shall be otherwise taken by the contractor to ensure that frames are not deformed or damaged by the hydraulic forces that occur during this process.
 7. Any grout or other bonding material shall be promptly cleaned off of frames or doors following installation. Hollow metal surfaces shall be kept free of grout, tar, or other bonding material or sealer.
 8. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 9. Exposed hollow metal surfaces which have been scratched or otherwise marred during installation, cleaning, and/or field welding, shall promptly be finished smooth, cleaned, treated for maximum paint adhesion and touched up with a rust inhibitive primer comparable to and compatible with the shop applied primer and finish paint specified in Section 099000.
- E. Stainless steel Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.

3.3 ADJUSTING AND CLEANING

- A. Clean grout and other bonding material off stainless steel doors and frames immediately after installation.
- B. Stainless Steel Touchup: Immediately after erection, smooth any scratched or damaged areas of stainless steel; polish to match undamaged finish.

END OF SECTION 081119

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory- finishing specifications.

C. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.

D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. 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.

E. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
2. Polymer edging, in manufacturer's standard colors.
3. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
4. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.6 QUALITY ASSURANCE

- A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 *Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products*, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

- B. Certified Wood: Wood products supplied under this section shall be FSC Certified. Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.
- C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations:

1. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.9 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 in a 42-by-84-inch section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch 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 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."
- B. Regional Materials: Wood doors shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- C. Certified Wood: Wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.
- D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

2.2 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND SIDELITE PANELS

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Oshkosh Door Company; GTFSC 5-Ply FSC Certified Structural Composite Lumber Core (NAUF)** doors or comparable product by one of the following:
 - a. Forte Openings
 - b. Oregon Door
 - 2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.

3. ANSI/WDMA I.S. 1A Quality Grade: Premium.
4. Faces: Single-plywood veneer not less than 1/50 inch thick.
 - a. Species: White oak.
 - b. Cut: Rift.
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: Running match.
 - e. Pair and Set Match: Provide for doors hung in same opening.

2.3 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.
- 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.
- 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."

2.4 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.
 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 1. Architectural Woodwork Standards Grade: Premium.
 - a. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
 2. Staining: None required.
 3. 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 and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 - 2. Machine doors for hardware.
 - 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - d. Comply with NFPA 80 for fire-rated doors.
 - 5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

- C. 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 084113

ALUMINUM-FRAMED STOREFRONTS AND CURTAINWALL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed curtain wall system, including arched transom framing.

B. Related Requirements:

1. Section 088000 "Glazing" and "Security Glazing".
2. Section 087100 "Door Hardware".

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes samples.
2. Operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Size: Manufacturers' standard size.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch 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.

- F. Delegated Design Submittals: For aluminum-framed storefront and curtain wall systems including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- G. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
 - 3. Environmental Product Declaration (EPD): For each product.
 - 4. Health Product Declaration (HPD): For each product.
 - 5. Third-Party Certifications: For each product.
 - 6. Third-Party-Certified Life-Cycle Assessment: For each product.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.

4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: For aluminum-framed entrance and curtain wall systems, accessories, and components, from manufacturer.
 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed storefront and curtain wall systems.
- B. Product Test Reports: For aluminum-framed storefront and curtain wall systems, for tests performed by a qualified testing agency .
- C. Source Quality-Control Reports: For aluminum-framed storefront and curtain wall systems.
- D. Delegated Design Engineer Qualifications: For aluminum-framed storefront and curtain wall systems.
- E. Sample Warranties: For aluminum-framed storefront and curtain wall systems.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed storefront and curtain wall systems.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.
- C. Egress Door Inspector Qualifications:
 1. Inspector for field quality-control inspections of egress door assemblies to comply with qualifications set forth in NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."

- D. 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 MOCKUPS

- A. Build mockups to set quality standards for materials and execution.
 - 1. Build mockup of typical (1) complete Aluminum Storefront as indicated on Drawings with a designated Storefront Type.
 - 2. Build mockup of Aluminum Curtain Wall at vestibule interior as indicated on drawings.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront 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 excessive deflection .
 - b. Deterioration of metals and other materials beyond normal weathering .
 - c. Noise or vibration created by wind and thermal and structural movements .
 - 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 SOURCE LIMITATIONS

- A. Obtain all components of aluminum-framed storefront and curtain wall systems, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed storefront and curtain wall systems.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefront and curtain wall systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed storefront and curtain wall systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of length of span of the framing member for lengths of up to 13 feet 6 inches and to 1/240 of length of span of the framing member plus 1/4 inch for lengths greater than 13 feet 6 inches .
 - 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 .
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
- E. 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.

F. 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 10 lbf/sq. ft. .

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 values complying with IECC code minimums for Project climate zone as determined in accordance with NFRC 100.
- b. Entrance Doors: U-factor of not more than values complying with IECC code minimums for Project climate zone as determined in accordance with NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

- a. Fixed Glazing and Framing Areas: SHGC for the system of not more than values complying with IECC code minimums for Project climate zone and installed unit's solar orientation as determined in accordance with NFRC 200.
- b. Entrance Doors: SHGC of not more than values complying with IECC code minimums for Project climate zone and installed unit's solar orientation as determined in accordance with NFRC 200.

3. Air Leakage:

- a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.
- b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, 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 .
 - b. Low Exterior Ambient-Air Temperature: 0 deg F .
 - c. Interior Ambient-Air Temperature: 75 deg F .

2.3 ALUMINUM-FRAMED STOREFRONT AND CURTAIN WALL SYSTEMS

- A. Basis-of-Design Exterior Storefront Product: Subject to compliance with requirements, provide Kawneer Company, Inc., Arconic Corporation; Trifab 451UT Framing System with 350T Insulpour Half-lite Door or comparable product by one of the following:
1. OldCastle BuildingEnvelope (OBE)
 2. YKK AP America Inc.
- B. Basis of Design Interior Curtain Wall Product: Subject to compliance with requirements, provide Kawneer Company, Inc., Arconic Corporation; 1600 System 1 Curtain wall with 350 Heavywall Entrance Door or comparable product by one of the following:
1. OldCastle BuildingEnvelope (OBE)
 2. YKK AP America Inc.
- C. 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. Interior Vestibule Framing Construction: Nonthermal ; designer may elect to use a nonthermal unit matching dimension, fit, and finish of exterior framing .
 3. Glazing System: Retained mechanically with gaskets on four sides .
 4. Glazing Plane: Center.
 5. Finish: Superior-performance organic finish.
 6. Finish: Manufacturer 70% fluoropolymer-based "Permafluor" finish meeting or exceeding AAMA 2605 requirements. Color to be selected by Owner and/or Architect.
 7. Fabrication Method: Field-fabricated stick system.
 8. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 9. Steel Reinforcement: As required by manufacturer.
 10. Curtainwall Framing: Curtainwall framing includes arched transom framing as indicated on Drawings.
- D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Entrance Doors: Refer to "088000 Security Glazing" for manual-swing or automatic operation.
1. Basis-of-Design product: Subject to compliance with requirements, provide 350T Insulpour Half-lite Door.
 2. Door Construction: 2- to 2-1/4-inch overall thickness, with minimum 0.125-inch- 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 .

3. Door Design: Medium stile; 3-1/2-inch nominal width .
4. Glazing Stops and Gaskets: Square , snap-on, extruded-aluminum stops and preformed gaskets.

- a. Provide nonremovable glazing stops on outside of door.

5. Finish: Match adjacent storefront framing finish.

G. Interior Vestibule Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Basis of Design product: Kawneer 350 Heavywall Entrance Door.

2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.5 GLAZING

- A. Glazing: Comply with Sections 088000 "Glazing".

- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

- C. Glazing Sealants: As recommended by manufacturer.

1. Product Data: Verify architectural sealant has a VOC content of 250 g/L or less.

- D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

1. Color: Match structural sealant.

2.6 MATERIALS

- A. Sheet and Plate: ASTM B209.

- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

- 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.
- F. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- G. Regional Materials: Verify products are manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

2.7 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. Avoid use of exposed fasteners to extent possible.
 - 4. Where required, use exposed fasteners with countersunk Phillips screw heads , finished to match framing system .
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch 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 thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Superior-Performance Organic Finish, Two-Coat Minimum PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments .
 - 2. Standard anodized finishes: Provide samples from manufacturer's full range, to be reviewed and confirmed by Architect and/or Owner in Submittal review.

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 OF EXTERIOR STOREFRONT AND INTERIOR CURTAIN WALL SYSTEMS

- 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 079200 "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.
- K. 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.
- L. Install glazing as specified in Section 088000 "Glazing".

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 MAINTENANCE SERVICE

- A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

END OF SECTION 084113

SECTION 085113
ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum windows for exterior locations, including: Fixed and project-in awning assemblies, simulated double hung, and true (operable) double hung.

1.2 RELATED SECTIONS

- A. 017329 Cut, Patch, Sleeve, Insert
- B. 024119 Selective Demolition
- C. 085656 Security Screen
- D. 088000 Glazing
- E. 088723 Safety and Security Films
- F. 079200 Joint Sealants

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.5 QUALITY ASSURANCE

- A. Mockups: Prepare a mockup of the first replacement installation of the W1A: Winco 4500S double hung window to demonstrate constructability and sealant capabilities and to set quality standards for materials and execution of the installation. If approved, it can become part of completed work.

1.6 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Warranty Period:

- a. Window: 2 years from date of Substantial Completion.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope. Installer should confirm dimensions with existing masonry openings on site prior to manufacture of window units.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- D. Sustainability and LEED Standards:
 - 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 - 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 - 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 - 4. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.1-2010
 - 5. California Air Resources Board (CARB) 2007
 - 6. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: AW90
 - 2. Minimum Performance Grade: HC90
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.60 Btu/sq. ft. x h x deg F.
- D. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 55.

- E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone [1] [2] [3] [4] for [basic] [enhanced] protection.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.

2.2 ALUMINUM WINDOWS

- A. Basis of Design Product: Subject to compliance with requirements, provide Winco; or a comparable product by one of the following:

1. Wausau Window and Wall Systems.
2. YKK AP America Inc.

- B. Window Types, as indicated on Drawings:

1. W1: WINCO 1450S:
8 over 8, simulated double hung, fixed aluminum window, with applied muntins.
2. W1A: WINCO 4500S:
8 over 8, true (operable) double hung, fixed aluminum window, with applied muntins.
3. W2: WINCO 1450S:
3 over 6, cottage style simulated double hung fixed aluminum window with applied muntins.
4. W2A: WINCO 4500S:
3 over 6, cottage style true (operable) double hung fixed aluminum window with applied muntins.
5. W3: WINCO 1450S:
10 over 10, simulated double hung, fixed aluminum window, with applied muntins.
6. W4: WINCO 1450S:
Fixed aluminum window
7. W5: WINCO 1450S:
In-swing awning aluminum window

- C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

- D. Glazing

1. Refer to section 088000 Glazing for glass units and glazing requirements applicable to glazed aluminum window units.

- E. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

F. Awning Window Hardware:

1. Locking:
 - a. Cast White Bronze Cam Locks (Standard)
 - b. Access Control Locks
 - c. Hook Lock Handle
 - d. Pivot Shoe Roto-Operator
2. Hinging:
 - a. 4-Bar Hinges (Standard)
 - b. Limit Stop

G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

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

2.3 ACCESSORIES

- A. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- B. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.4 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.5 ALUMINUM FINISHES

- A. Finish: AAMA 2604, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Provide initial samples in the three standard shades of anodized bronze, for final selection by Architect. Provide larger final sample for verification.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085113

SECTION 085656
SECURITY SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Security screens for installation at exterior windows where indicated.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of security screen specified.
- B. Shop Drawings: Showing details of attachment to surrounding materials and elevations showing scope of the project.
- C. Samples: For each product and finish specified.

1.3 Warranty

- A. The operation of the security screen supplied by Kane Innovations on the designated project is warranted for one (1) year against any proven defective material or parts, as called for in the specifications and approved shop drawings. This warranty does not cover abuse by others.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating

ing extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight

relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from approved third party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: actively engaged in the fabrication of specified items for a minimum of five (5) years prior to the bid date.
- B. Performance and testing must comply with impact test, sag test and forced entry resistance test of SMA 6001-02. Manufacturer must submit the AAMA Notice of Product Certification in compliance with CFR 200.935 as "Security Screen - Heavy". Security screens must provide Threat Level 5, Heavy Vandalism protection.

PART 2 - PRODUCTS

2.1 SECURITY SCREENS

- A. Security Screen: Hinged metal security screens for installation at aluminum windows.

1. Basis-of-Design Product: Subject to compliance with requirements, provide S-NR5-O Level 5: Heavy Vandalism Screens, by Kane Architectural Innovations, or equal. Provide reveal mounting as indicated on Drawings or surface mount if required per field conditions for appropriate installation of security screens.

2.2 Acceptable Manufacturers

Kane Innovations, Erie, PA
(800) 773-2439

2.3 Main Frame

- A. The main frame rails shall be not less than 16-gauge 1" [25.4mm] x 1" [25.4mm] seamless welded galvanized steel tubing with high strength die cast metal corners which are pneumatically inserted into the frame ends with an interference fit.
- B. A removable face plate, extruded from 6063-T6 aluminum alloy, .062-inch thick, .212 lbs./ft., shall be attached to the sides of the main frame using tamper resistant screws.

2.4 Finish

- A. The aluminum faceplates shall be thoroughly cleaned in a 5-step bonderizing process. An electrostatically applied thermoplastic, polyester powder coating (2.5 mil min. thickness) shall be applied and baked to a hard mar-resistant finish in one of Kane's standard colors. Coating shall meet or exceed AAMA 2603.

Color: Dark Bronze

- B. The main and infill shall be thoroughly cleaned in a 5-step bonderizing process. An electrostatically applied black, thermoplastic, polyester powder coating (2.5 mil min. thickness) shall be applied and baked to a hard mar-resistant finish. Coating shall meet or exceed AAMA 2603.

2.5 Infill

- A. Perforated Panel: 12-gauge mill-galvannealed with 51% open area

2.6 Infill Attachment

- A. The perforated panel shall be attached to the main frame with hex-head Tek Screws.
- B. Hex-head Tek screws shall penetrate the infill and main frame approximately 4" [101.6] on center.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that openings fit allowable tolerance, are plumb, level, provide a solid anchoring surface and comply with approved shop drawings.

3.2 INSTALLATION

- A. Install in accordance with approved shop drawings and specifications.
- B. Plumb and align faces in a single plane and erect screens square and true, adequately anchored to structure.

C. After completion of installation, screens shall be adjusted, in working order and cleaned.

END OF SECTION 085656

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. 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 06 Section "Rough Carpentry".
 - 3. Division 06 Section "Finish Carpentry".
 - 4. Division 08 Section "Operations and Maintenance".
 - 5. Division 08 Section "Hollow Metal Doors and Frames".
 - 6. Division 08 Section "Stainless Steel Doors and Frames".
 - 7. Division 08 Section "Flush Wood Doors".
 - 8. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 9. Division 26 Section "Electrical"
- 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.
 - 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:
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 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
- 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 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.

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 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 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. McKinney (MK) - TA/T4A Series, 5-knuckle.
 - c. dormakaba BEST (ST) - F/FBB 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. Pemko (PE).
 - c. dormakaba BEST (ST).
- B. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.
 - 1. Manufacturers:

- a. Hager Companies (HA).
- b. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
- c. Pemko (PE).
- d. dormakaba BEST (ST).

2.4 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. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
 - 1. Manufacturers:
 - a. Door Controls International (DC).
 - b. Rockwood (RO).
 - c. Trimco (TC).
- C. 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. Hiawatha, Inc. (HI).

- b. Rockwood (RO).
- c. Trimco (TC).

2.5 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. Match Existing, Field Verify.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 - 4. Tubular deadlocks and other auxiliary locks.
 - 5. 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.
 - 6. Keyway: Match Facility Standard.
- C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- 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. Existing System: Field verify and key cylinders to match Owner's existing system.
- 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).
- F. 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.

2.6 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - ML2000 Series.
- b. Sargent Manufacturing (SA) - 8200 Series.
- c. Schlage (SC) - L9000 Series.

2.7 CYLINDRICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

- a. Meets ANSI/BHMA A156.41 for single motion egress.
- b. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
- c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
- d. Exceeds ANSI/BHMA A156.2 requirements by 2.6 times for 3,100 in-lb. abusive locked lever torque with no entry while maintaining egress.
- e. Exceeds ANSI/BHMA A156.2 requirements by 8 times for 1,600 lbs. offset lever pull with no entry for protection against attacks.
- f. Exceeds ANSI/BHMA A156.3 requirements by 2 times for latch retraction with 100 lb. preload while maintaining operation in warped doors.
- g. Exceeds ANSI/BHMA A156.3 requirements by 20 times for no access with minimum 100 vertical impacts for protection against vandalism attempts.
- h. Independent return springs allow lock to exceed ANSI/BHMA A156.2 Grade 1 cycle requirements without lever sag.
- i. Status indicators inside, outside, or on both sides of doors as specified with high visibility red/green or red/white icons to display locked or unlocked state in the rose.
- j. Ten-year limited warranty for mechanical functions.

2. Manufacturers:

- a. Corbin Russwin Hardware (RU) - CLX3300 Series.
- b. Sargent Manufacturing (SA) - 10X Line.
- c. Schlage (SC) - ND Series.

2.8 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 Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
- 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 ELECTROMAGNETIC LOCKING DEVICES

- A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 2 with minimum holding force strength of 1,200 pounds. Locks to be capable of accepting between 12 to 24 volts direct current and be UL listed for use on fire rated door assemblies. Electromagnetic coils are to consume no more than 1.5W during normal operation. Locks are to have an integrated door position switch, tamper switch, and lock bond sensor. Locks are to have integrated motion sensor and/or security camera as indicated in the hardware sets. Locks to be capable of detecting door prop conditions and entering low power mode. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Manufacturers:
 - a. Securitron (SU) - M680E Series.

2.10 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.
 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. Provide exit devices with functions and features as follows:
 - a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - c. No catch points: addition of applied deflectors or other added components are not allowed.
 - d. No visible plastic.
 - e. Heavy duty end caps with flush and overlapping options made of stainless steel, brass, or bronze with architectural finishes.
 - f. Constructed of all stainless steel.
 - g. Stainless steel pullman type latch with deadlock feature.
 - h. Narrow or wide style exterior trim as specified in the hardware sets.
 - i. Center case adjustability on concealed vertical rod exit devices; single operation with hex key individually adjusts top or bottom latches. No retainer screws or clips required to maintain adjustment.
 - j. Ten-year limited warranty for mechanical features.
 - 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - PED4000 / PED5000 Series.
 - b. Sargent Manufacturing (SA) - PE80 Series.
 - c. Von Duprin (VD) - 35A/98 XP Series.

2.11 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 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. 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.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. 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.
 2. Manufacturers:
 - a. LCN Closers (LC) - 4040 Series.
 - b. Norton Rixson (NO) - 7500 Series.
 - c. Sargent Manufacturing (SA) - 351 Series.

2.12 ELECTROHYDRAULIC DOOR OPERATORS

- A. Electrohydraulic Door Operators (High Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that meet ANSI/BHMA A156.4 requirements and are UL listed for use on fire rated doors and UL10C certified that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall be verified by GreenCircle to offer energy savings of 19% when compared to similar products to accommodate openings up 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.
 - b. Operates as mechanical surface closer during close cycles, when door is opened manually or if power is off.
 - c. Activation by push button, hands-free or radio frequency devices.
 - d. On board electronics to collect usage and cycle count data to facilitate preventative maintenance/diagnostics.
 - e. Two-year limited warranty.
 - f. 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.
 - g. Mounting backplate to simplify and speed up installation.
- 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. Infinite Hold Open: Door will hold open at set position until power is turned off.
 - d. 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.
 - e. Open Delay: Delays operator opening for locking hardware.
 - f. Overload Safety Shut-Off: After two minutes of receiving a door activation signal, inverter times out and door closes to prevent motor/inverter damage.
 - g. Presence Detector Input: Input for external sensor to detect presence at door open or close position only.
 - h. Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.
 - i. 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.
 - j. 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.
- 3. Manufacturers:
 - a. Norton Rixson (NO) - 6000 Series.

2.13 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. Hiawatha, Inc. (HI).
- b. Rockwood (RO).
- c. Trimco (TC).

2.14 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. Hiawatha, Inc. (HI).
- 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 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).

2.15 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 UL 10C 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.
- F. Manufacturers:
 1. National Guard Products (NG).
 2. Pemko (PE).
 3. Reese Enterprises, Inc. (RE).

2.16 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 1. Manufacturers:
 - a. Alarm Controls (AK) - CP1-1026 Series.
 - b. Security Door Controls (SD) - DPS Series.
 - c. Securitron (SU) - DPS Series.
- B. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 1. Power supplies shall meet all functions and features as specified herein.
 - a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
 - b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
 - c. Enhanced surge immunity for input/output protection
 - d. Separate, dedicated battery charging circuit to keep locks cooler.
 - e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
 - f. Instant auto-switch to battery on AC loss.
 - g. Expandable up to 16 outputs in the standard enclosure
 - h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
 - i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
 - j. Lifetime replacement, no-fault, no questions asked warranty.

2. Manufacturers:

- a. Life Safety Power (LP).
- b. Securitron (SU) - AQL Series.

2.17 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.

2.18 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.

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."
 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.
- 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 handling 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.
 - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Door Hardware Sets, Manufacturer's Abbreviations:
 - 1. MK - McKinney
 - 2. PE - Pemko
 - 3. MR - Markar
 - 4. RO - Rockwood
 - 5. SA - SARGENT
 - 6. SU - Securitron
 - 7. NO - Norton Rixson

Hardware Sets

Set: 1.0

Doors: 101A, ST1

1 Continuous Hinge	CFM__SLI-HD1 X LAR
1 Magnetic Lock (w/ motion sensor)	M680EBDX
1 Rim Exit Device, Storeroom	16 70 PE8804 Less Pull
1 Pull	RM2230-12 (mounting as required)
1 Automatic Opener (with UNI stop arm)	6061 D
1 Gasketing	By Door Manufacturer
1 Sweep	307APK
1 Threshold	271A MSES10SS
1 Wiring Diagram	WD-SYSPK (Elevations and Point to Point)
1 Position Switch	DPS-M-BK
1 Operator Wall Switch	700 (wave to open)
1 Pushbutton	EEB2
1 Power Supply w/ Distribution Board	AQL4-R8E1

Notes: CARD READER BY SECURITY VENDOR. EXTERIOR: PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK MAGNETIC LOCK AND ACTIVATE OPERATOR ALLOWING ACCESS. INTERIOR: PUSHING DOOR SWITCH WILL UNLOCK MAGNETIC LOCK AND ACTIVATE OPERATOR ALLOWING EGRESS. MOTION DETECTOR WILL UNLOCK MAGNETIC LOCK ALLOWING EGRESS. MAGNETIC LOCK UNLOCKS WHEN FIRE ALARM IS ACTIVATED. EXIT DEVICES ARE DOGGED BY CYLINDER WHEN OPERATOR IS IN USE.

Set: 2.0

Doors: 007B, 014E

1 Continuous Hinge (Lead Lined)	FM300 LAR
1 Rim Exit Device, Storeroom (alarmed)	AL 70 8804 ETND
1 Core	Core to match existing system
1 Surface Closer	CPS7500 (brackets and drop plate as required)
1 Astragal	18041CNB
1 Gasketing	S88BL (Head & Jambs)
1 Rain Guard	346C
1 Threshold	273x3AFG MSES10SS
1 Position Switch	DPS-M-BK

Notes: ALARM IN EXIT DEVICE IS ACTIVATED WITH PUSHING OF TOUCH BAR. KEY TURNS ON AND OFF ALARM.

Set: 3.0

Doors: 101B

2	Continuous Hinge	CFM__HD1 X LAR
1	Mullion	L980S 86"
1	Magnetic Lock (w/ motion sensor)	M680EBDX
1	Rim Exit Device, Storeroom	16 70 PE8804 Less Pull
1	Rim Exit Device, Exit Only	16 70 PE8810 EO
3	Core	Core to match existing system
2	Pull	RM2230-12 (mounting as required)
2	Conc Overhead Stop	6-X36
2	Surface Closer	PR7500 (brackets and drop plate as required)
2	Kick Plate	K1050 10" high BEV CSK
1	Astragal	18041CNB
1	Gasketing	S88BL (Head & Jambs)
1	Rain Guard	346C
2	Sweep	307APK
1	Threshold	273x3AFG MSES10SS
1	Wiring Diagram	WD-SYSPK (Elevations and Point to Point)
2	Position Switch	DPS-M-BK
1	Pushbutton	EEB2
1	Power Supply w/ Distribution Board	AQL4-R8E1

Notes: CARD READER BY SECURITY VENDOR. EXTERIOR: PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK MAGNETIC LOCK ALLOWING ACCESS. INTERIOR: ACTIVATION OF INTEGRAL MOTION SENSOR WILL UNLOCK MAGNETIC LOCK AND REQUEST EXIT ALLOWING EGRESS. PUSHING EMERGENCY PUSH BUTTON WILL UNLOCK MAGNETIC LOCK ALLOWING EGRESS.

Set: 4.0

Doors: 110A, 110B

2	Continuous Hinge	CFM__HD1 X LAR
2	Flush Bolt (manual)	555 (metal) / 557 (wood)
1	Dust Proof Strike	570
1	Storeroom/Closet Lock	70 10XG04 LND

1 Core	Core to match existing system
2 Surface Closer	CPS7500 (brackets and drop plate as required)
2 Kick Plate	K1050 10" high BEV CSK
1 Astragal	18041CNCB
1 Gasketing	2891APK (Head)
2 Gasketing	290APK (Jambs)
1 Rain Guard	346C
2 Sweep	307APK
1 Threshold	1715A MSES25
2 Position Switch	DPS-M-BK

Set: 5.0

Doors: 101C

2 Continuous Hinge	CFM__HD1 X LAR
2 Magnetic Lock (w/ motion sensor)	M680EBDX
2 Pull	RM2230-12 (mounting as required)
2 Push Bar	RM2202 (mounting as required)
1 Automatic Opener (pair, UNI stop arm)	D6061-36 D
1 Astragal	S771C
1 Gasketing	S88BL (Head & Jambs)
1 Wiring Diagram	WD-SYSPK (Elevations and Point to Point)
2 Operator Wall Switch	700 (wave to open)
1 Pushbutton	EEB2
1 Power Supply w/ Distribution Board	AQL4-R8E1

Notes: CARD READER BY SECURITY VENDOR. EXTERIOR: PRESENTING AUTHORIZED CREDENTIAL TO CARD READER WILL UNLOCK MAGNETIC LOCK AND ACTIVATE OPERATOR ALLOWING ACCESS. INTERIOR: PUSHING DOOR SWITCH WILL UNLOCK MAGNETIC LOCK AND ACTIVATE OPERATOR ALLOWING EGRESS. MOTION DETECTOR WILL UNLOCK MAGNETIC LOCK ALLOWING EGRESS. MAGNETIC LOCK UNLOCKS WHEN FIRE ALARM IS ACTIVATED.

Set: 6.0

Doors: 107

6 Hinge, Full Mortise, Hvy Wt	T4A3786 NRP
1 Mullion	L980S 86"
2 Rim Exit Device, Storeroom	16 70 PE8804 WEND

4	Core	Core to match existing system
2	Surface Closer	CLP7500 (brackets and drop plate as required)
2	Kick Plate	K1050 10" high BEV CSK
1	Astragal	S771C
1	Gasketing	S88BL (Head & Jambs)

Set: 7.0

Doors: 014D

3	Hinge (heavy weight)	T4A3786
1	Rim Exit Device, Classroom	12 70 PE8813 WEND
1	Core	Core to match existing system
1	Surface Closer	CLP7500 (brackets and drop plate as required)
1	Kick Plate	K1050 10" high BEV CSK
1	Gasketing	S88BL (Head & Jambs)

Set: 8.0

Doors: 007A

3	Hinge (heavy weight)	T4A3786
1	Rim Exit Device, Passage	12 PE8815 WEND
1	Surface Closer	7500 (brackets and drop plate as required)
1	Kick Plate	K1050 10" high BEV CSK
1	Wall/ Floor Stop	RM861 / RM850
1	Gasketing	S88BL (Head & Jambs)

Set: 9.0

Doors: 011B, 014B

6	Hinge, Full Mortise	TA2714
2	Flush Bolt (manual)	555 (metal) / 557 (wood)
1	Dust Proof Strike	570
1	Storeroom/Closet Lock	70 10XG04 LND
1	Core	Core to match existing system
2	Surface Closer	(PR) 7500 (Reg or PA) (brackets and drop plate as required)
2	Kick Plate	K1050 10" high BEV CSK
2	Wall/ Floor Stop	RM861 / RM850
2	Silencer	608

Set: 10.0

Doors: 009, 012B

6 Hinge, Full Mortise	TA2714
1 Flush Bolt (set, automatic)	2842/2942
1 Dust Proof Strike	570
1 Storeroom/Closet Lock	70 10XG04 LND
1 Core	Core to match existing system
1 Coordinator	2672 Wear Plates
2 Surface Closer	(PR) 7500 (Reg or PA) (brackets and drop plate as required)
2 Kick Plate	K1050 10" high BEV CSK
2 Wall/ Floor Stop	RM861 / RM850
1 Astragal	S771C
1 Gasketing	S88BL (Head & Jambs)

Set: 11.0

Doors: 008

6 Hinge, Full Mortise	TA2714
1 Flush Bolt (set, automatic)	2842/2942
1 Dust Proof Strike	570
1 Storeroom/Closet Lock	70 10XG04 LND
1 Core	Core to match existing system
1 Coordinator	2672 Wear Plates
2 Surface Closer	CLP7500 (brackets and drop plate as required)
2 Kick Plate	K1050 10" high BEV CSK
1 Astragal	S771C
1 Gasketing	S88BL (Head & Jambs)

Set: 12.0

Doors: 014A, 108B

3 Hinge, Full Mortise	TA2714xNRP
1 Storeroom/Closet Lock	70 10XG04 LND
1 Core	Core to match existing system
1 Surface Overhead Holder/Stop	10-X46
3 Silencer	608

Set: 13.0

Doors: 013

3 Hinge, Full Mortise	TA2714
1 Storeroom/Closet Lock	70 10XG04 LND
1 Core	Core to match existing system
1 Surface Closer	(PR) 7500 (Reg or PA) (brackets and drop plate as required)
1 Kick Plate	K1050 10" high BEV CSK
1 Wall/ Floor Stop	RM861 / RM850
3 Silencer	608

Set: 14.0

Doors: 010, 011A, 012A

3 Hinge, Full Mortise	TA2714
1 Storeroom/Closet Lock	70 10XG04 LND
1 Core	Core to match existing system
1 Surface Closer	(PR) 7500 (Reg or PA) (brackets and drop plate as required)
1 Kick Plate	K1050 10" high BEV CSK
1 Wall/ Floor Stop	RM861 / RM850
1 Gasketing	S88BL (Head & Jambs)

Set: 15.0

Doors: 108A

3 Hinge, Full Mortise	TA2714
1 Classroom Lock	70 10XG37 LND
1 Core	Core to match existing system
1 Wall/ Floor Stop	RM861 / RM850
3 Silencer	608

Set: 16.0

Doors: 003, 004, 006, 109

3 Hinge, Full Mortise	TA2714
1 Classroom Lock	70 10XG37 LND
1 Core	Core to match existing system

1	Surface Closer	7500 (brackets and drop plate as required)
1	Kick Plate	K1050 10" high BEV CSK
1	Wall/ Floor Stop	RM861 / RM850
1	Gasketing	S88BL (Head & Jambs)

Set: 17.0

Doors: 004A

3	Hinge, Full Mortise	TA2714
1	Privacy Lock	10XU65 VSL
1	Core	Core to match existing system
1	Wall/ Floor Stop	RM861 / RM850
3	Silencer	608

Set: 18.0

Doors: 002, 103

3	Hinge, Full Mortise	TA2714
1	Hotel Guest Lock Lock	V21 70 8250 LNND
1	Core	Core to match existing system
1	Surface Closer	CLP7500 (brackets and drop plate as required)
1	Kick Plate	K1050 10" high BEV CSK
1	Gasketing	S88BL (Head & Jambs)

Set: 19.0

Doors: 004B, 106

3	Hinge, Full Mortise	TA2714
1	Hotel Guest Lock Lock	V21 70 8250 LNND
1	Core	Core to match existing system
1	Surface Closer	7500 (brackets and drop plate as required)
1	Kick Plate	K1050 10" high BEV CSK
1	Wall/ Floor Stop	RM861 / RM850
1	Gasketing	S88BL (Head & Jambs)

Set: 20.0

Doors: ST2

1	Rim Exit Device, Storeroom	16 70 PE8804 WEND

1 Core

Core to match existing system

Notes: REMAINDER OF HARDWARE BY GATE MANUFACTURER.

END OF SECTION 087100

SECTION 088000

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following applications:

1. Windows.
2. Interior doors.
3. Exterior doors.
4. Exterior storefront.
5. Interior curtain wall.

1.2 RELATED SECTIONS

- 1. 085113 - Aluminum Windows
- 2. 084113 - Aluminum-framed Storefronts and Curtainwalls
- 3. 088723 - Safety and Security Films

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- D. Preconstruction adhesion and compatibility test report.
- E. Warranty.

1.5 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 - 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 - 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.6 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. 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 labeling is indicated or required, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Sustainability and LEED Standards:
 - 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 - 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 - 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 - 4. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.1-2010
 - 5. California Air Resources Board (CARB) 2007
 - 6. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass 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 on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by Guardian Glass; Sunguard, or a comparable product by one of the following:
 - 1. Vitro Architectural Glass (formerly PPG Glass).
 - 2. Pilkington North America.
- B. For security glazed areas, and subject to compliance with requirements, provide products by Childguard/Accessgard.
- C. For impact resistant film, provide products by Riotlite.
- D. For privacy glass, provide products by McGrory Glass.

2.3 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Frosted (Privacy) Glass Basis of Design: McGrory, SMPA-111. Security Glazing: ASTM F1233 Class 1.4 Forced Entry Resistance.

2.4 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by Guardian Glass; Solar Control Low-E Glass, in locations indicated on drawings.

- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal with manufacturer's standard primary and secondary.
2. Spacer: Aluminum with, color as selected by Architect.

2.5 MONOLITHIC-GLASS TYPES

- A. Glass Type E: Clear fully tempered float glass
1. Thickness: 1/4 inch (6.0 mm).
- B. Glass Type F (Privacy Glass): Frosted fully tempered float glass
1. Thickness: 1/4 inch (6.0 mm).
 2. Basis of Design Product: McGrory Glass, SMPA-111

2.6 INSULATING-GLASS TYPES

- A. Glass Type A: Clear Low-E coated, tempered, insulated glazing unit.
1. Overall Unit Thickness: 1 inch (25 mm)
 2. Thickness of Each Glass Lite: 1/4" Inch
 3. Visible Light Transmittance: 62% minimum
 4. Winter Nighttime U-Factor: .28 maximum
 5. Summer Daytime U-Factor: .27 maximum
 6. Solar Heat Gain Coefficient: .27 maximum
 7. UV Transmittance 6% maximum
 8. Shading Coefficient: .31
 9. Composition: 1/4" Guardian SNX 62/27 #2 – 1/2" air space - 1/4" clear tempered float
- B. Glass Type B: Clear, Low-E coated, tempered, insulated glazing unit with impact resistant film (#2 surface).
1. Overall Unit Thickness: 1 inch (25 mm)
 2. Thickness of Each Glass Lite: 1/4" Inch
 3. Visible Light Transmittance: 62% minimum
 4. Winter Nighttime U-Factor: .28 maximum
 5. Summer Daytime U-Factor: .27 maximum
 6. Solar Heat Gain Coefficient: .27 maximum
 7. UV Transmittance 6% maximum
 8. Shading Coefficient: .31
 9. Composition: 1/4" Guardian SNX 62/27 #2 – 1/2" Air Space - 1/4" clear tempered float
 10. Impact Resistant Film: See Section 088723.
- C. Glass Type C: 1" Privacy, Low-E Coated, tempered, Insulated Glazing Unit with impact resistant film (#2 surface);

Basis of Design - Privacy: McGrory Glass, SMPA-111

1. Overall Unit Thickness: 1 inch (25 mm)
2. Thickness of Each Glass Lite: 1/4" Inch
3. Visible Light Transmittance: 62% minimum
4. Winter Nighttime U-Factor: .28 maximum

5. Summer Daytime U-Factor: .27 maximum
6. Solar Heat Gain Coefficient: .27 maximum
7. UV Transmittance 6% maximum
8. Shading Coefficient: .31
9. Composition: 1/4" Guardian SNX 62/27 #2 – 1/2" Air Space - 1/4" clear tempered float
10. Impact Resistant Film: See Section 088723.

D. Glass Type D: 1" Clear, Low-E Coated (#3 surface), tempered, Insulated Glazing Unit with security glazing (outer lite).

1. Overall Unit Thickness: 1 inch (25 mm)
2. Thickness of Each Glass Lite: 1/4" Inch
3. Visible Light Transmittance: 62% minimum
4. Winter Nighttime U-Factor: .28 maximum
5. Summer Daytime U-Factor: .27 maximum
6. Solar Heat Gain Coefficient: .27 maximum
7. UV Transmittance 6% maximum
8. Shading Coefficient: .31
9. Composition: 1/4" security glazing (exterior) – 1/2" Air Space - 1/4" clear tempered float (interior)
10. Security glazing: Childguard/Accessgard.

E. Glass Type E: 1/4" Clear fully tempered float glass.

1. Minimum Thickness: 6 mm / 1/4".
2. Applications: Interior Curtainwall. Coordinate with curtainwall manufacturer.

GLAZING GASKETS

F. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

G. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will 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. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
 4. Colors of Exposed Glazing Sealants: As selected by Department from manufacturer's full range.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 SECURITY GLAZING MATERIALS

- A. Extruded Aluminum: ASTM B221, 6063 alloy.
- B. Neoprene Glazing Gaskets:
 - 2.1 Interior Glazing gaskets closed cell cellular neoprene conforming to ASTM C509 Type II Option 1 with a 40-50 Shore A Durometer.
 - 2.2 Exterior Glazing gaskets solid neoprene conforming to ASTM C864 with a 65-75 Shore A Durometer.
- C. Weatherstripping: Entrance manufacturer's standard types to suit application.
- D. Fasteners: Stainless steel or corrosion resistant steel. Security fasteners only.
- E. Glazing Sealants and Adhesives:
 - 2.1 Dow 795 for exterior finish applications.
 - 2.2 Dow 795 or 3M IPA for interior finish applications.
 - 2.3 Dow 999-A for weather seal applications.

2.11 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

PART 3 - EXECUTION

3.1 SECURITY GLAZING INSTALLATION

- B. Impact Security Factory Trained Certified Dealers Only.
- C. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
- D. Install plumb, level, square, true to line, and without warp or rack.
- E. Provide all fasteners required for installation.
- F. Anchor frames securely in place to support. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction.
- G. Joint Sealants: Install joint sealants as specified in Section 07 21 19 - Foamed-In-Place Insulation Foamed-In-Place Insulation.
- H. Adjust door equipment for correct function and smooth operation. Verify water and weather tight installation as applicable.

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed

and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. 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; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 088723

SAFETY AND SECURITY FILMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Security film system for glazing.

1.2 RELATED SECTIONS

- A. 07 92 00 - Joint Sealants
- B. 08 51 13 - Aluminum Windows
- C. 08 41 00 – Aluminum-framed Storefronts and Curtainwalls
- D. 08 80 00 - Glazing

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - 2. ASTM D1044 - Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion by the Taber Abraser.
 - 3. ASTM E308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE System.
 - 4. ASTM E903 - Standard Methods of Test for Solar Absorbance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
 - 5. ASTM F3561 - Standard Test Method for Forced-Entry-Resistance of Fenestration Systems After Simulated Active Shooter Attack.
 - 6. ASTM F588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013330 - Submittals.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods and details.
- C. Verification Samples: Two representative units of each type, thickness, pattern, and color. Sample size: 6 by 6 inches (152.4 by 152.4 mm).

1.5 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria

compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.

5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity. Company must be a certified RiotLite Installer.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- D. Clearly label each film roll with product designation and lot number.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.8 PROJECT CONDITIONS

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

1.9 WARRANTY

- A. Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Impact Security LLC, which is located at: 400 Glover St. Marietta, GA 30060 Email: [request info \(info@defenselite.com\)](mailto:info@defenselite.com); Web: <https://www.defenselite.com>
- B. Substitutions: Not permitted.

2.2 SYSTEM DESCRIPTION

- A. Film Material: Optically clear polyester film with a durable abrasion-resistant coating on one side and UV-stabilized pressure-sensitive adhesive on the other.
- B. Adhesive Material: Pressure-sensitive weatherable acrylic adhesive applied

uniformly, ensuring optical clarity and no distortion when viewed from a distance of 10 feet (3 m) at angles up to 45 degrees.

2.3 PERFORMANCE REQUIREMENTS

- A. Standards Compliance:
 - 1. Forced-Entry Rating Level: RiotLite 27 mil film meets the requirements of ASTM F3561 Level 3 when installed on 1/4 inch (6.35 mm) single pane tempered glass with structural caulk anchor, installed on aluminum commercial glazing frames.
 - 2. Forced-Entry Resistance: RiotLite 27 mil film meets the requirements of ASTM F588, Type D, Grade 40.

2.4 SECURITY FILM SYSTEM FOR GLAZING

- A. RiotLite Security Film, 27 mil Thickness
 - 1. Performance Properties on Single Pane 1/4 inch (6.35 mm) Clear Glass:
 - a. Solar Heat Gain Coefficient: 0.82.
 - b. Visible Light Transmitted: 85 percent.
 - c. Visible Light Reflected (Interior): 8 percent.
 - d. Visible Light Reflected (Exterior): 8 percent.
 - e. U-Value: 1.03.
 - f. UV Block: 99 percent.
 - g. Total Solar Energy Rejected: 19 percent..
 - h. Glare Reduction: 1 percent
 - 2. Product Strength Data:
 - a. Tensile Strength: 32,000 PSI.
 - b. Break Strength: 700 lbs per inch (12.5 kg per mm).
 - c. Puncture Strength: Greater than 355 lbs (161 kg).
 - d. Elongation: Greater than 200 percent.
 - e. Peel Strength: Greater than 5 lbs per inch (0.1 kg per mm).

PART 3 EXECUTION

3.1 EXAMINATION

- A. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.
- B. Examine glass surfaces to receive new film and verify that they are free from defects and imperfections, which will affect the final appearance.
- C. Correct all such deficiencies before starting the film application process.

3.2 PREPARATION

- A. Clean window and window framing surfaces thoroughly using a neutral cleaning solution. Scrape inside surface of window glass with a stainless steel razor blade with a clean, sharp edge to ensure the removal of any foreign contaminants without damage to the glass surface.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
- B. Installation must be performed by a certified RiotLite installer.

- C. Cut film to specifications utilizing a sharp razor blade neatly and square at a uniform distance of 1/16 inch (1.6 mm) of the window-sealing device.
- D. Apply film using a wet application method with clean water and slip solution to facilitate positioning of the film onto the glass.
- E. Use a stiff polyurethane squeegee to remove excess water from the underside of the film and maximize adhesive bonding of the pressure sensitive adhesive.
- F. Upon completion, film may have a dimpled appearance from residual moisture. Said moisture shall, under reasonable weather conditions, dry flat with no moisture dimples within a period of 90 days when viewed under normal viewing conditions.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- A. Clean film using common non-abrasive window cleaning solutions.
- B. Avoid ammonia-based cleaners for metallized constructions.
- C. Do not use abrasive type cleaning agents and bristle brushes which could scratch the film.
- D. Repair or replace damaged products before Substantial Completion.

END OF SECTION 088723.

SECTION 089119

FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed louvers LV-1 and LV-2 in Mechanical Drawings and in front façade pediment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

D. Samples: For each type of metal finish required.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. **Product Material Cost:** Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. **Product Data for Credit - Environmental Product Declarations (EPD):** For all products that meet EPD requirements, EPDs with relevant sections highlighted.

3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Sample Warranties: For manufacturer's special warranties.

1.5 FIELD CONDITIONS

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

1.6 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.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. 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, ambient; 180 deg F, 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 Drainable-Blade Louver, Extruded Aluminum:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Ruskin; ELF6375DX Drainable Stationary Louver** or comparable product by one of the following:

- a. Architectural Louvers Co.; Harray, LLC
 - b. Cesco Products; MESTEK, Inc.
 - c. Construction Specialties, Inc.
 - d. Greenheck Fan Corporation
- 2. Louver Depth: 6 inches.
- 3. Color: Match to window frames.
- 4. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
- 5. Mullion Type: Exposed.
- 6. Louver Performance Ratings:
 - a. Free Area: Not less than 57% for 48-inch- wide by 48-inch- high louver.
- 7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. 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 from each corner and at 12 inches 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: Non-rewirable, U-shaped frames.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening, Aluminum: 1/2-inch- square mesh, 0.063-inch wire.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, 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 hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
 - 3. 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.
- C. Maintain equal louver blade spacing to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - 2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 - 3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.

2.7 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with 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 for seacoast and severe environments.
 - 2. Color and Gloss: As selected by Architect from manufacturer's full range. Initial basis of

design selection "Medium Bronze (72)" or "Dark Bronze (75)" to be reviewed and confirmed in Submittal review.

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.
- 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 09 01 10.15

PAINT AND COATING REMOVAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DESCRIPTION

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of paint and coating removal as shown on the Drawings, as specified herein, and as may be required by conditions and authorities having jurisdiction, including, but not limited to, the following:
 - 1. Removing paint and coatings from stucco by hand scraping and chemical paint removal.
 - 2. Removing paint and coatings from unit masonry by hand scraping and chemical paint removal.
 - 3. Removing paint and coating from terra cotta by chemical paint removal only.
- B. Intent: It is the specific intent of this Section to provide for removing paints and coatings from surfaces as specified to provide substrates free of paints, coatings, and finishes without damaging or deteriorating elements and materials from which coatings have been removed and without damaging or deteriorating adjacent elements, materials, and finishes and other elements, materials, and finishes that are not part of the work of this Section. All work required to accomplish this intent shall be included as work of this Section.
- C. Related Work Specified Elsewhere
 - 1. Historic Treatment Procedures – Section 013591
 - 2. Historic Removal and Dismantling – Section 024296
 - 3. Stucco Restoration – Section 092423
 - 4. Exterior Painting and Coatings – Section 099113

1.3 QUALITY ASSURANCE

- A. Paint and Coating Removal Specialist: Award paint and coating removal work to firm regularly engaged in removing paints and coatings from historic building elements and materials similar to the paint and coating removal work required by this Section that can demonstrate to Owner's satisfaction that, within previous five years, the firm has successfully performed and completed in a timely manner at least three projects similar in scope and type to work required on this Project involving buildings designated as Landmarks by local governmental authorities, buildings listed in the National Register of Historic Places, or buildings listed in a State Register of Historic Places under the direction of preservation authorities.

1. Foreman: Paint and coating removal work shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Paint and Coating Removal Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on Project throughout work of this Section unless Owner deems foreman's performance unacceptable.
 2. Mechanics: Paint and coating removal work shall be carried out by a steady crew of skilled mechanics who are thoroughly experienced in the removal of paints and coatings from historic building elements and materials and who have a minimum of five years' experience with work on historic buildings similar to that required by this Section. In acceptance or rejection of work of this Section, no allowance will be made for workers' inattention or lack of skill.
- B. Laws, Codes, and Regulations: Work of this Section shall comply with applicable federal, state, and local laws, codes, and regulations.
- C. Access for Observation and Approvals: Provide Architect access on a continuing basis to locations on which mock-ups are being carried out, on which work is ongoing, and where work has been completed to allow for observation and approvals. Provide means of access complying with laws and regulations regarding safety and acceptable to Architect. Provide manpower and equipment to facilitate observation and approvals.
1. Extent of Access: No approval of work will be given before Architect is provided hands-on access to all surfaces that have been restored. Provide access for reinspection of areas where work was not approved on first or subsequent inspections until Architect approves work.
 2. Relocation of Means of Access: If Contractor moves means of access before providing Architect with hands-on access to every location in which work was performed, Contractor shall reinstall means of access to provide for close-up inspection by Architect at no additional cost to Owner.
- D. Knowledge of Site and Project Conditions: Before submitting bid, Bidders shall make themselves thoroughly familiar with the Drawings and Specifications, with the scope of this Project, and with conditions at the Project site relating to requirements of this Section and limitations under which the work will be performed and shall determine or verify dimensions and quantities. Submission of a bid shall be considered conclusive evidence that Contractor is thoroughly familiar with Project requirements and site conditions and limitations.

1.4 SUBMITTALS

- A. General: Submit the following in compliance with the requirements of the Contract Documents. Revise and resubmit each item as required to obtain Architect's approval.
- B. Qualification Data: Submit qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three completed projects similar in size and scope to work required on this Project. For each project list project name, address, architect, conservator, supervising preservation agency, scope of contractor's work, and other relevant information. Submit this information with the bid.

- C. Product Data: Manufacturer's published technical data for each product to be used in work of this Section including material description, chemical composition (ingredients and proportions), physical properties, recommendations for application and use, test reports and certificates verifying that product complies with specified requirements, and Safety Data Sheets (SDS).
- D. Work Description: Prior to beginning paint and coating removal work on site, submit detailed written description of proposed removal work for each type of coating on each type of substrate. Submit new written descriptive information. Photocopies of Contract Documents, excerpts from Contract Documents, and/or duplication of text in Contract Documents will not be accepted for Work Description. Do not begin work on site until work description has been approved in writing. Description for each material on each substrate shall include, but not be limited to:
 - 1. General Process: Materials, methods, tools, and equipment for each condition of removal work.
 - 2. Protection: Description, including drawings and diagrams, of proposed materials and methods of protection for preventing harm, damage, and deterioration caused by work of this Section to all persons (whether involved in the Work or not), building elements, materials, and finishes, surrounding landscape and site, and the environment (including air and water).
 - 3. Alternate Coating Removal Methods and Materials (If Any): Contractor proposed alternate methods and materials (if any) to those specified for paint and coating removal work. Provide evidence of successful use on comparable projects and demonstrate effectiveness for use on this Project.
- E. Waste Disposal Program: Proposed materials and methods for collection, treatment, and legal, offsite disposal of wastes resulting from work of this Section.

1.5 TESTING

- A. General: Before beginning general paint and coatings removal or preparing mock-ups, test paint and coating removal methods on sample areas to determine most appropriate product and method for each coating and substrate. Testing will consist of graduated trials beginning with the least aggressive method and testing more aggressive methods once it is proven that gentler methods are not acceptable to the Architect. A successful test is one where all loose and flaking paint and coatings are removed without causing damage or deterioration of the substrate. Tightly adhered paint and coatings may remain if required to prevent damage to substrate. Do not proceed with paint and coating removal mock-ups until Architect has approved results of testing.
 - 1. Locate tests as directed by Architect.
 - 2. Size of Test Panels
 - a. Removing Paints and Coatings from Stucco Surfaces: 1 sq. ft.
 - b. Removing Paints and Coatings from Unit Masonry Surfaces: 1 sq. ft.
 - c. Removing Paints and Coatings from Terra Cotta Surfaces: Four locations (column capital, column base, string course, 1 sq ft each, and one rosette).
 - 3. Notify Architect 48 hours prior to start of testing.
 - 4. Provide Architect opportunity to be present during testing. Architect will monitor testing in progress at their discretion. Architect can reject test panels not performed in their presence.
 - 5. Use crew that will execute work and follow requirements of this Section.

6. Stop testing and remove product from surface immediately using appropriate solvent upon observing any adverse effect to substrate.
- B. Following hand scraping, test the following methods to remove paint and coatings from stucco surfaces:
 1. Chemical Paint and Coatings Removal Methods: Test each product specified. Perform additional tests using different dwell times and other variations as directed by Architect to determine most effective product and procedure for removing paint and coatings from each surface without causing damage.
- C. Following hand scraping, test the following methods to remove paint and coatings from unit masonry surfaces:
 1. Chemical Paint and Coatings Removal Methods: Test each product specified. Perform additional tests using different dwell times and other variations as directed by Architect to determine most effective product and procedure for removing paint and coatings from each surface without causing damage.
- D. Test the following methods to remove paint and coatings from terra cotta surfaces:
 1. Chemical Paint and Coatings Removal Methods: Test each product specified. Perform additional tests using different dwell times and other variations as directed by Architect to determine most effective product and procedure for removing paint and coatings from each surface without causing damage.

1.6 MOCK-UPS

- A. General: Following testing and before beginning general paint and coating removal work, prepare mock-ups to provide standards for paint and coating removal work. Do not proceed with paint and coating removal work until Architect has approved mock-ups.
 1. Locate mock-ups as directed by Architect.
 2. Notify Architect 48 hours prior to start of each mock-up.
 3. Provide Architect opportunity to be present during mock-ups. Architect will monitor mock-ups in progress at their discretion. Architect can reject mock-ups not performed in their presence.
 4. Use crew that will execute the work and follow requirements of this Section.
 5. Repeat mock-ups as necessary to obtain Architect's approval.
 6. Protect approved mock-ups to ensure that they are without damage, deterioration, or alteration at time of Substantial Completion.
 7. Approved mock-ups in undamaged condition at time of Substantial Completion may be incorporated into the Work.
 8. Approved mock-ups will represent minimum standards for paint and coating removal work. Subsequent paint and coating removal work that does not meet standards of approved mock-ups will be rejected.
- B. Prepare the Following Mock-Ups
 1. Removing Paint from Stucco Surfaces: One location, 36 sq. ft.
 2. Removing Paint from Unit Masonry Surfaces: One location, 36 sq. ft.
 3. Removing Paint from Terra Cotta Surfaces: Four locations, ionic column capital, column base, string course, rosette.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products and materials to prevent damage, deterioration, or degradation and intrusion of foreign material.
- B. Discard and remove from site deteriorated materials, contaminated materials, and products that have exceeded their expiration dates. Replace with fresh materials.

1.8 PROJECT CONDITIONS

- A. Safety: Protect all persons, whether or not they are involved with work of this Section, from harm caused by work of this Section.
 - 1. Ensure adequate ventilation during work of this Section.
 - 2. Ensure that workers are fully protected from contact with abrasives, chemicals, dust, coating residues, and other materials generated by work of this Section.
- B. Protection of Building: Protect building elements and finishes from damage and from deterioration caused by work of this Section. Repair damage to materials and damage to finishes to Architect's satisfaction at no additional cost to Owner.
 - 1. Take precautions necessary to prevent fire and spread of fire.
 - a. Do not use torches, heat guns, or any other heat generating equipment to remove paint.
 - b. Place paint- or solvent-soaked rags, waste, overalls, and other material that might constitute a fire hazard in metal containers and remove from Project site daily.
- C. Coordination: Coordinate work of this Section with other work to ensure proper completion of the Work.
- D. Preconstruction Meeting: Convene a preconstruction meeting to discuss paint and coating removal and its effect on adjacent elements, materials, and finishes. Attendees shall include Owner's Representatives, Architect, Construction Manager, firm(s) that will perform paint and coating removal, and other entities that might be affected by paint and coating removal work.

1.9 LEAD-CONTAINING PAINT (LCP)

- A. General: Perform work that disturbs lead-containing paint (LCP), handle material that involves lead-containing paint, and transport and dispose of lead-containing paint and residue in compliance with applicable federal, state, and local laws and regulations for identification, removal, labeling, handling, containerization, transportation, and disposal of lead-containing material including, but not limited to, those referenced herein.
- B. U.S. Department of Labor OSHA Regulations: Including but not limited to: Title 29, Code of Federal Regulations (CFR) Section 1926.62: "Lead Exposure in Construction" and Title 29, CFR Section 1910.1200: "Hazard Communication Standard."
- C. U.S. Environmental Protection Agency (USEPA) Regulations: Including but not limited to: Title 40 CFR Part 262: "Standards Applicable to Generators of Hazardous Waste" and Part 263: "Standards Applicable to Transporters of Hazardous Waste."

- D. U.S. Department of Transportation (USDOT) Regulations: Including but not limited to: 49 CFR Parts 172, 173, 174, 175, 177, 178, 179, and 180.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Temperature Requirements: Use coating removers only when temperature of air, temperature of substrate, and temperature of remover comply with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 CHEMICAL PAINT AND COATING REMOVERS

- A. General
 1. Specified Strippers: Furnish specified strippers for mock-ups and for general paint and coating removal work.
 2. Strippers for Testing: Test strippers as specified herein. Furnish strippers selected during testing for mock-ups and for general paint and coating removal work.
 - a. Use and test only solvent-type paint strippers using N-methyl pyrrolidone or benzyl alcohol as primary solvent. Do not use alkali, acid-based, or methylene chloride-based paint strippers.
 3. Alternatives: Alternative strippers may be selected based on Project conditions. Furnish products selected for paint and coating removal at no additional cost to Owner.
- B. Strippers for Removing Coatings from Stucco Surfaces: Test each of the following products, or approved equal, on each type of coating to be removed. Perform additional tests using different dwell times and other variations as directed by Architect to determine most effective product and procedure for removing each type of paint and coating from each substrate.
 1. Light Duty Paint Remover, as available from Cathedral Stone Products, 7266 Park Circle Dr., Hanover, MD 21076 (410-782-9150).
 2. Smart-Strip Pro, as manufactured by Dumond Chemicals, Inc., 1475 Phoenixville Pike - Suite 18, West Chester, PA 19380 (800) 245-1191.
- C. Strippers for Removing Coatings from Unit Masonry Surfaces: Test each of the following products, or approved equal, on each type of coating to be removed. Perform additional tests using different dwell times and other variations as directed by Architect to determine most effective product and procedure for removing each type of paint and coating from each substrate.
 1. Light Duty Paint Remover, as available from Cathedral Stone Products, 7266 Park Circle Dr., Hanover, MD 21076 (410-782-9150).
 2. Smart-Strip Pro, as manufactured by Dumond Chemicals, Inc., 1475 Phoenixville Pike - Suite 18, West Chester, PA 19380 (800) 245-1191.
- D. Strippers for Removing Coatings from Terra Cotta Surfaces: Test each of the following products, or approved equal, on each type of coating to be removed. Perform additional tests using different dwell times and other variations as directed by Architect to determine most effective product and procedure for removing each type of paint and coating from each substrate.

1. Light Duty Paint Remover, as available from Cathedral Stone Products, 7266 Park Circle Dr., Hanover, MD 21076 (410-782-9150).
2. Heavy Duty Paint Remover, as available from Cathedral Stone Products., 7266 Park Circle Dr., Hanover, MD 21076 (410-782-9150).
3. Smart-Strip Pro, as manufactured by Dumond Chemicals, Inc., 1475 Phoenixville Pike - Suite 18, West Chester, PA 19380 (800) 245-1191
4. Enviro Klean SafStrip, as available from PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS 66046 (800-255-4255).
5. Enviro Klean SafStrip 8, as available from PROSOCO, Inc., 3741 Greenway Circle, Lawrence, KS 66046 (800-255-4255).

2.2 MISCELLANEOUS TOOLS AND EQUIPMENT

- A. Hand Tools for Removing Coatings from Stucco, Unit Masonry, and Terra Cotta on Site: Scrapers, putty knives, and other tools suitable for removing coatings.
- B. Vacuum for Rinse Water and Cleaning Effluent Collection: Wet/dry vacuum of sufficient capacity to collect effluent.
- C. Buckets for Cleaning Compounds and Rinsing: Molded rubber or plastic buckets.
- D. Brushes: Fiber-bristle brushes.
- E. Tools for Removing Paint and Chemical Strippers: Plastic scrapers and putty knives with rounded edges that will not scratch substrate.
- F. Non-metallic Cleaning Pads: Scotch-Brite General-Purpose (Maroon) Pads and Ultra-Fine (Gray) Hand Pads as manufactured by 3M Company, 3M Center, St. Paul, MN 55144, or approved equal.
- G. Sponges: Clean natural sponges in various sizes for rinsing.
- H. Cloths: Clean, lint-free cotton rags and cheesecloth.
- I. pH Strips: Non-staining, strips of appropriate range. Furnish pH strips onsite for the duration of work of this Section.

PART 3 - EXECUTION

3.1 PROTECTION

- A. General: Install protection and waste collection systems as described in approved Work Description prior to start of work.
- B. Protection from Hazardous Materials: Erect protection as necessary to protect workers, public, and environment from hazardous materials, including, but not limited to, lead-based paint, chemicals, abrasives, and dust.

- C. Protection of Adjacent Materials: Erect protection to prevent materials not to be stripped from damage and from deterioration resulting from water, chemicals, abrasives, coating residues, and other work of paint and coating removal.
- D. Waste Collection and Disposal: Provide containment system to collect and treat water, abrasives, coating residues, and other materials of this Section. Dispose of collected materials legally offsite.

3.2 TESTING AND MOCK-UPS

- A. General: Perform testing and mock-ups as directed to determine materials and methods for removing paints and coatings from substrates for which specific products and procedures are not specified herein.

3.3 PAINT AND COATING REMOVAL, GENERAL

- A. General: Perform paint and coating removal in a manner that results in removing paints and coatings to clean substrates and provides condition matching that of approved mock-ups using least aggressive method that removes paint from specified surfaces.
- B. Manufacturer's Recommendations: Apply and remove stripping materials to comply with manufacturer's recommendations using procedures developed during testing and mock-ups.
- C. Uniform Results: Perform stripping in a manner that achieves uniform results on all surfaces, including corners and moldings, without streaking or damage.
- D. Methods of Paint and Coating Removal: Remove paint and coatings from the following elements using methods specified.
- E. Cleaning and Neutralization: Clean residue from stripped surfaces at completion of stripping, leaving surface in optimum condition to accept specified finish.

3.4 CHEMICAL PAINT REMOVAL METHODS, GENERAL

- A. Selection: Use paint stripper specified. Where paint strippers are to be chosen during testing, use stripper found during testing to be gentlest, most effective method for removing each type of coating system from each substrate as approved by Architect.
- B. Procedure (Subject to modification during testing and mock-ups)
 1. Install protection.
 2. Remove as much paint and coatings as possible for stucco and unit masonry surfaces by hand using scrapers that will not mar substrate surface. Do not perform hand scraping for terra cotta surfaces.
 3. Apply chemical stripper. Allow to dwell for approved time, as determined by test panels and mock-ups.
 4. Manually agitate and scrape off paint stripper and softened paint to greatest extent possible.

5. Repeat process as needed to completely remove paint and coatings and residue from paint and coatings.
6. Rinse surfaces using solvents recommended by manufacturer of paint stripper to remove paint and stripper residue.
 - a. Rinse strippers with water. Water pressure shall not exceed 500 psi.
 - b. Provide an analysis of rinse water showing quantity of hazardous materials, including lead, in water. If required because of lead concentration, contain, collect, and dispose of water by legal means.
7. Conduct final wipe down to remove residue using solvents and clean cloths. Repeat until cloths come away clean.

3.5 MECHANICALLY REMOVING PAINT AND COATINGS FROM STUCCO AND UNIT MASONRY

- A. General: Remove as much paint as possible from flat and dimensional/profiled stucco and unit masonry surfaces as required to prepare for chemical stripping. Do not damage substrate.
- B. Hand Scraping: Use a variety of scrapers with shapes matching the profiles of the moldings. Scrapers should be held at low angles for optimal paint removal.
- C. Dust Removal: Vacuum surfaces to remove remaining contaminants.

3.6 CHEMICALLY REMOVING PAINT FROM STUCCO, UNIT MASONRY, AND TERRA COTTA.

- A. General: Remove paint from stucco in locations indicated on Drawings as specified herein.
- B. Removing Loose Dust and Dirt: Before beginning coating removal, remove loose dust and dirt.
- C. Sealing Cracks: Seal wide cracks using backer rod to prevent water entry.
- D. Stripper Application: Apply paint stripper to painted surfaces following manufacturer's instructions.
- E. Dwell Time: Allow stripper to remain on surface for a minimum of two hours and up to maximum duration recommended by manufacturer. Do not allow stripper to dry on surface. Apply additional stripper or cover with plastic sheeting to ensure that material remains moist.
- F. Removal: Scrape stripper and coating from surface using plastic scrapers with rounded corners. Remove remaining coating using stiff, fiber bristle scrub brushes, sponges, and water. Contractor may use pressure washer/vacuum recycling machine as long as cracks are sealed to prevent water entry.
- G. Repeating Removal: Repeat removal process as required to remove paint to achieve surface matching approved mock-up to Architect's satisfaction.

3.7 CLEAN-UP AND PROTECTION

- A. Clean-up: Properly contain run-off and debris from paint and coating removal. Remove rubbish, rags, and effluent from site at end of each workday, in appropriately marked containers. Dispose of material generated by work of this Section offsite in a legal manner.
- B. Protection: Protect work of other trades against damage and deterioration by paint and coating removal work. Correct damage by cleaning, repairing, or replacing elements, materials, and finishes damaged or deteriorated by paint and coating removal work, as acceptable to Architect, at no additional cost to Owner.

END OF SECTION 09 01 10.15

SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstructural steel framing for all partitions, except 3A, and suspended gypsum ceilings.
2. Sound absorbing ceiling unit suspension struts in Staff Workroom 108 and Meeting Room 109.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing, structural framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of nonstructural steel framing and fastening and anchorage details.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, and attachments to adjoining work.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.

1.4 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product.

Estimated cost at time of submittal is permissible.

2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For code-compliance certification of studs and track.
- B. Evaluation Reports: From ICC-ES showing compliance with Project requirements, for the following:
 1. Studs and track.
 2. Equivalent corrosion-resistant coating on steel framing.
 3. Firestop track.
 4. Post-installed anchors.
 5. Power-actuated anchors.

1.6 QUALITY ASSURANCE

- A. Sustainability and LEED Standards:
 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 3. Sustainable Agriculture Network's Sustainable Agriculture Standard

4. Forest Stewardship Council (FSC)
 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
 6. California Air Resources Board (CARB) 2007 *Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products*, Phase 2
 7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011
- B. Code-Compliance Certification of Studs and Track: Provide documentation that framing members are certified in accordance with product-certification program of the Steel Framing Industry Association the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Protect materials from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For composite wall assemblies, limited to 1/240 of the wall height based on the following horizontal loading:
 1. Horizontal Loading: 5 lb./sq. ft.

2.2 NONSTRUCTURAL STEEL FRAMING

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with requirements in AISI S220 for conditions indicated on Drawings.
 1. Protective Coating: ASTM A653/A653M, G60 hot-dip galvanized or coating with

demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.

- a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.
- C. Studs and Track: Conventional members, roll-formed into standard shapes without surface deformations to stiffen framing members.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CEMCO; California Expanded Metal Products Co.**
 - b. **ClarkDietrich**
 - c. **Jaimes Industries, Inc.**
 - d. **MBA Metal Framing**
 - e. **SCAFCO Steel Stud Company; Stone Group of Companies**
 2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
 3. Minimum Yield Strength: 33 ksi.
 4. Depth: As indicated on Drawings.
- D. Firestop Track: Top track manufactured to allow partition heads to expand and contract with movement of structure above while maintaining continuity of fire-resistance-rated assembly indicated on Drawings; in base-steel thickness not less than that of studs and in width to accommodate depth of studs.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CEMCO; California Expanded Metal Products Co.**
 - b. **ClarkDietrich**
 - c. **SCAFCO Steel Stud Company; Stone Group of Companies**
- E. Rigid Hat-Shaped Furring Channels: Conventional members, roll-formed into standard shapes.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CEMCO; California Expanded Metal Products Co.**
 - b. **ClarkDietrich**
 - c. **Jaimes Industries, Inc.**
 - d. **MBA Metal Framing**
 - e. **SCAFCO Steel Stud Company; Stone Group of Companies**
 2. Minimum Base-Steel Thickness: 0.0296 inch.
 3. Depth: As indicated on Drawings.
- F. Steel Strut Channels: Conventional members, roll-formed into standard shapes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CEMCO; California Expanded Metal Products Co.**
 - b. **ClarkDietrich**
 - c. **Jaimes Industries, Inc.**
 - d. **MBA Metal Framing**
 - e. **SCAFCO Steel Stud Company; Stone Group of Companies**
2. Minimum Steel Thickness: 0.105 inch.
3. Depth: As indicated on Drawings.

2.3 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. Adjustable Wall-Furring Brackets: Steel sheet in minimum 0.0329-inch- base-steel thickness with serrated edges for attaching furring channels to exterior masonry or concrete walls.
 1. Protective Coating: ASTM A653/A653M, G60 , hot-dip galvanized.
- C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 1. Tire Wire for Adjustable Wall-Furring Brackets: Use minimum double strand of 0.0625-inch- diameter wire, or triple strand of 0.0475-inch- diameter wire to attach furring channels.
 2. Tire Wire for Suspended-Ceiling Systems:
 - a. Splicing Carrying Channels and Furring Members: Use double loops of minimum 0.0625-inch- diameter wire.
 - b. Saddle Tying Main Runners and Cross Furring: Use minimum 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- D. Post-Installed Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, as appropriate for the substrate.
- E. Power-Actuated Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- F. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 1. Diameter: 0.162 inch.
- G. Flat Hangers: Steel sheet.
 1. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized.
 2. Size and Length: In size indicated on Drawings.
- H. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, substrates, and conditions, with Installer present, 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.
 1. Furnish concrete inserts and other devices required to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING, 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 framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

- A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.

2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
 4. Suspended Applications: Install framing at 24 inches on-center unless otherwise indicated on the drawings.
- 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 track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated on Drawings 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 on Drawings.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure unless otherwise indicated on Drawings.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. 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 on Drawings and support closures to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Install to maintain continuity of fire-resistance-rated assembly indicated on Drawings.
 5. STC-Rated Partitions: Install framing to comply with STC-rated assembly indicated on Drawings.
- E. Direct Furring:
1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Suspended Assemblies: Isolate suspension assemblies from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- G. Installation Tolerances for Nonstructural Steel Framing:
1. Framing Members: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

2. Suspended Assemblies: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092300
GYPSUM PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Finish-coat gypsum plaster materials, for repair and patching purposes.

B. Related Requirements:

1. Section 017329 "Cut, Patch, Sleeves and Ins" for modifications to plaster surfaces.
2. Section 061000 "Rough Carpentry"

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

- B. Shop Drawings:** Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

C. Sustainable Design Submittals:

1. Health Product Declaration (HPD): Provide documentation indicating that manufacturer has screened and publicly provided ingredient disclosure to 1000 ppm and has developed an action plan to mitigate known hazards.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form:** For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. **Product Material Cost:** Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.

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2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 *Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products*, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 FIELD CONDITIONS

- A. Comply with ASTM C842 requirements or gypsum plaster manufacturer's written instructions, whichever are more stringent.
- B. Room Temperatures: Maintain temperatures at not less than 55 deg F or greater than 80 deg F for at least seven days before application of gypsum plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.
- C. Avoid conditions that result in gypsum plaster drying out too quickly.
 - 1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
 - 2. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
 - 3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated on Drawings, provide gypsum plaster assemblies identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by a qualified testing agency.
- B. Sound-Transmission Characteristics: Where indicated on Drawings, provide gypsum plaster assemblies identical to those of assemblies tested for STC ratings in accordance with ASTM E90 and classified in accordance with ASTM E413 by a qualified testing agency.

2.2 FINISH-COAT GYPSUM PLASTER MATERIALS

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, factory-mixed, gaged, interior finish.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Gold Bond Building Products, LLC provided by National Gypsum Company
 - b. USG Corporation
- C. Lime: ASTM C206, Type N, normal finishing hydrated lime.

2.3 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Bonding Compound: ASTM C631; recommended by plaster manufacturer for application indicated.
- C. Fasteners for Attaching Metal Lath to Substrates: ASTM C841.
- D. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- F. Mix Additives: Use gypsum plaster accelerator and retarder products of plaster manufacturer if required by Project conditions. Use only additives that plaster manufacturer recommends in writing for use with plaster to which it is added.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components in accordance with requirements for design designations from listing organization and publication indicated on Drawings.
- B. STC-Rated Assemblies: Install components in accordance with requirements for design designations from listing organization and publication indicated on Drawings.
- C. Acoustical Sealant: seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.2 APPLICATION OF PLASTER

- A. General: Comply with ASTM C842.
 - 1. Do not deviate more than plus or minus 1/8 inch in 10 ft. from a true plane in finished plaster surfaces when measured by a 10-ft. straightedge placed on surface.
 - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - 3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- B. Bonding Compound: Apply on unit masonry substrates for direct application of plaster.

3.3 INSTALLATION OF FINISH-COAT GYPSUM PLASTER MATERIALS

A. Smooth-Troweled Finishes:

1. Materials: Gypsum ready-mixed finish plaster
2. Locations: Provide smooth-troweled finish unless otherwise indicated. Match adjacent construction.

B. Concealed Plaster:

1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.
3. Where plaster application is used as a base for adhesive application of tile and similar finishes, omit finish coat.

END OF SECTION 092300

SECTION 09 24 23

STUCCO RESTORATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DESCRIPTION

- A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of stucco restoration as shown on the Drawings and/or as specified herein and as may be required by conditions and authorities having jurisdiction, including, but not necessarily limited to, the following:
1. Routing cracks greater than 1/4 inch wide and patching cracks with replication stucco. Finishing stucco patch surface to match texture of adjacent existing stucco.
 2. Removing loose and deteriorated stucco to sound material and patching with replication stucco. Finishing stucco patch surface to match texture of adjacent existing stucco.
 3. Patching areas of loss larger than 6 sq. in. and deeper than 1/4 inch with replication stucco. Finishing stucco patch surface to match texture of adjacent existing stucco.
 4. Removing deteriorated stucco and providing new replication stucco to rebuild original profile of decorative oval element at pediment.
 5. Providing new supports, metal lath, fasteners, and accessories in locations with deteriorated lath.
 6. Removing abandoned metal anchors from stucco surfaces and patching areas of loss in stucco left by removal.
- B. Related Work Specified Elsewhere
1. Historic Treatment Procedures – Section 013591
 2. Historic Removal and Dismantling – Section 024296
 3. Paint and Coating Removal – Section 090110.15
 4. Exterior Painting and Coatings – Section 099113
 5. Masonry Pointing – Section

1.3 QUALITY ASSURANCE

- A. Stucco Restoration Specialist: Award stucco restoration work to a firm regularly engaged in stucco restoration that can demonstrate to Owner's satisfaction that, within previous five years, it has successfully performed and completed in a timely manner at least three projects similar in scope and type to work required on this Project involving buildings designated as Landmarks by local governmental authorities, buildings listed in the National Register of

Historic Places, or buildings listed in a State Register of Historic Places under the direction of preservation authorities.

1. Foreman: Stucco restoration work shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Stucco Restoration Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on Project throughout work unless Owner deems his performance unacceptable.
 2. Mechanics: Stucco restoration work shall be carried out by a steady crew of skilled plasterers who are thoroughly experienced with materials and methods specified and have a minimum of three years' experience with stucco work similar to that required by this Section. In acceptance or rejection of work of this Section, no allowance will be made for workers' inattention or lack of skill.
- B. Laws, Codes, and Regulations: Work of this Section shall comply with applicable federal, state, and local laws, codes, and regulations.
- C. Referenced Standards: Comply with applicable requirements and recommendations of latest editions of the documents listed herein, except as modified by more stringent requirements of the Contract Documents and of applicable laws, codes, and regulations of authorities having jurisdiction. In each case in which there is a conflict between requirements of referenced standards; requirements of laws, codes, and regulations; and requirements of relevant technical sections, the most stringent or restrictive requirement shall govern.
1. American National Standards Institute (ANSI)
 - a. ANSI A42.2, Portland Cement and Portland Cement-Lime Plastering, Exterior (Stucco) and Interior.
 2. ASTM International (ASTM)
 - a. ASTM A 276, Standard Specification for Stainless Steel Bars and Shapes.
 - b. ASTM A 580, Standard Specification for Stainless Steel Wire.
 - c. ASTM C 150, Standard Specification for Portland Cement.
 - d. ASTM C 207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - e. ASTM C 897, Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
 - f. ASTM C 926, Standard Specification for Application of Portland Cement-Based Plaster.
 - g. ASTM C 1063, Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
 3. Portland Cement Association (PCA): Portland Cement Plaster/Stucco Manual.
- D. Sources of Materials: Obtain each type of material required for stucco restoration from a single source to ensure a match in quality, performance, and appearance.
- E. Allowable Tolerances: Stucco surfaces shall be true and flat and continuous in plane and profiles. Correct irregularities observable by the naked eye to provide smooth, even, uniform, plumb and level surfaces. Architect will reject stucco exhibiting ridges, ledges, and other irregularities, and Contractor shall remove rejected work and provide new work at no additional cost.
1. Existing Surfaces: Repaired areas of stucco shall match adjacent arrises and surfaces to provide continuous, straight, even lines and planes.

- F. Access for Observation and Approvals: Provide Architect access on a continuing basis to locations on which mock-ups are being carried out, on which work is ongoing, and where work has been completed to allow for observation and approvals. Provide means of access complying with laws and regulations regarding safety and acceptable to Architect. Provide manpower and equipment to facilitate observation and approvals.
1. Extent of Access: No approval of work will be given before Architect is provided hands-on access to all surfaces that have been restored. Provide access for reinspection of areas where work was not approved on first or subsequent inspections until Architect approves work.
 2. Relocation of Means of Access: If Contractor moves means of access before providing Architect with hands-on access to every location in which work was performed, Contractor shall reinstall means of access to provide for close-up inspection by Architect at no additional cost to Owner.
- G. Knowledge of Site and Project Conditions: Before submitting bid, Bidders shall make themselves thoroughly familiar with the Drawings and Specifications, with the scope of this Project, and with conditions at the Project site relating to requirements of this Section and limitations under which the work will be performed and shall determine or verify dimensions and quantities. Submission of a bid shall be considered conclusive evidence that Contractor is thoroughly familiar with Project requirements and site conditions and limitations.

1.4 SUBMITTALS

- A. General: Submit the following in compliance with the requirements of the Contract Documents. Revise and resubmit each item as required to obtain Architect's approval.
- B. Qualification Data: Qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three completed projects similar in size and scope to the work required on this Project. For each project list project name, address, architect, conservator, supervising preservation agency, scope of contractor's work, and other relevant information. Submit this information with the bid.
- C. Product Literature: Manufacturer's published technical data for each product to be used in work of this Section including material description, chemical composition (ingredients and proportions), physical properties, recommendations for application and use, test reports and certificates verifying that product complies with specified requirements, and Safety Data Sheets (SDS).
- D. Work Description: Detailed description of proposed materials and methods for stucco restoration work. Do not begin work on site until work description has been approved in writing. Submit new written descriptive information. Photocopies of Contract Documents, excerpts from Contract Documents, and/or duplication of text in Contract Documents will not be accepted for Work Description. Description shall include, but not be limited to:
1. Materials and Procedure: Materials, methods, tools, and equipment to be used for stucco restoration work.

2. Protection: Description, including drawings, of proposed materials and methods of protection for preventing harm, damage, and deterioration caused by work of this Section to persons (whether involved in the Work or not), building elements, materials, and finishes, surrounding landscape and site, and the environment (including air and water).
3. Alternate Methods and Materials (If Any): Proposed alternate methods and materials (if any) to those specified for stucco restoration work. Provide evidence of successful use on comparable projects and demonstrate effectiveness for use on this Project.
4. Documentation of Additional Restoration Work Following Paint Removal: Annotated elevations indicating all additional repairs. Submit documentation of additional stucco work to Architect for review and approval prior to starting any additional work.

E. Samples

1. Stainless Steel Lath: 8-inch-square pieces.
2. Stucco to Match Existing: Two samples of three-coat stucco on masonry substrate, 16 inches high x 24 inches long.
 - a. Finish coat texture and color to match existing portland cement stucco skim coat.

F. Material Certificates: For each kind of stucco aggregate, submit certificate signed by manufacturer of aggregate certifying that material complies with requirements.

G. Prepare mock-ups for approval as specified in Article "Mock-Ups," below.

1.5 MOCK-UPS

A. General: Before beginning stucco work, prepare mock-ups to provide standards for work of this Section. Do not proceed with stucco work until Architect has approved mock-ups.

1. Locate mock-ups as directed by Architect.
2. Notify Architect 48 hours prior to start of each mock-up.
3. Provide Architect opportunity to be present during mock-ups. Architect will monitor mock-ups in progress at their discretion. Architect can reject mock-ups not performed in their presence.
4. Use crew that will execute the work and follow requirements of this Section.
5. Repeat mock-ups as necessary to obtain Architect's approval.
6. Allow mock-ups to dry for seven days to allow stucco to reach final color and allow potential problems to appear. Notify Architect when mock-ups are ready for review.
7. Protect approved mock-ups to ensure that they are without damage, deterioration, or alteration at time of Substantial Completion.
8. Approved mock-ups in undamaged condition at time of Substantial Completion may be incorporated into the Work.
9. Approved mock-ups will represent minimum standards for stucco restoration work. Subsequent stucco restoration work that does not meet standards of approved mock-ups will be rejected.

B. Prepare the Following Mock-Ups

1. Routing and patching crack in stucco: Two cracks, minimum one linear foot.
2. Removing loose and deteriorated stucco and providing replication stucco matching adjacent existing stucco: Two locations, one flat stucco and one dimensional/profiled stucco, minimum one square foot.

3. Patching areas of loss with replication stucco. Finish stucco patch surface to match texture of adjacent existing stucco: Two locations, one flat stucco and one dimensional/profiled stucco, minimum one square foot.
4. Removing deteriorated stucco and providing new replication stucco to rebuild original profile of decorative oval element at pediment: one feature, minimum 6 sq. in.
5. Removing abandoned metal anchors from stucco surfaces and patching areas of loss in stucco left by removal: Two locations.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products and materials to prevent damage, deterioration, degradation, and intrusion of foreign material.
- B. Discard and remove from site deteriorated materials, contaminated materials, and products that have exceeded their expiration dates. Replace with fresh materials.
 1. Do not use cement that has hardened or partially set or products containing cement that has hardened or partially set. Remove cement from the site and provide new fresh cement.

1.7 PROJECT CONDITIONS

- A. Safety: Protect all persons, whether or not involved in the work of this Section, from harm caused by or resulting from work of this Section.
- B. Protection of Building: Protect building elements and finishes from damage and from deterioration caused by work of this Section. Repair damage to materials and damage to finishes to Architect's satisfaction at no additional cost.
 1. Prevention of Staining: Prevent stucco materials from staining exposed faces of adjacent masonry and other materials.
- C. Responsibility for Dimensions: Dimensions of existing elements and conditions in Contract Documents, whether numerical, tabular, or graphic, are provided for bidding purposes and for Contractor's information and are not guaranteed. Contractor shall measure existing elements and conditions in field before preparing shop drawings, ordering materials, or starting construction and shall certify on shop drawings that dimensions have been field verified. Contractor is responsible for verifying dimensions of existing construction and for preparation of new work and replacement work fitting into and aligning with existing construction.
- D. Coordination: Sequence stucco restoration properly with installation and protection of other work, so that neither stucco nor other work will be damaged or deteriorated.
- E. Preconstruction Meeting: Convene a preconstruction meeting to discuss stucco restoration work and its effect on adjacent elements, materials, and finishes. Attendees shall include Owner's Representatives, Architect, Construction Manager, firm that will perform stucco restoration work, and other entities that might be affected by stucco restoration work.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. General: Comply with requirements of referenced stucco application standards and requirements specified herein for environmental conditions before, during, and after stucco application. In case of conflict, the most stringent requirement shall govern in each case.
- B. Cold-Weather Requirements: Provide heat and protection to ensure that each coat of stucco does not freeze for at least 48 hours after application. Provide heat evenly and uniformly to prevent concentration of heat on stucco near heat sources.
- C. Warm-Weather Requirements: Protect stucco against uneven and excessive evaporation and from strong flows of dry air. Apply and cure stucco to prevent it from drying during cure period. Provide water-retaining coverings, moist curing, protection from sunlight and wind, or combinations of these measures, as necessary to ensure proper cure.
- D. Temperature for Stucco Application: Do not apply stucco when ambient temperature is below 45 deg F or above 85 deg F.

PART 2 - PRODUCTS

2.1 STUCCO MATERIALS

- A. Portland Cement for Base and Finish Coats: ASTM C 150, Type 3 (High Early Strength).
 - 1. Provide white cement, gray Portland cement, or a combination of white Portland cement and gray Portland cement as required to mix stucco matching color of existing portland cement skim coat.
- B. Lime: Special hydrated lime for finishing purposes, ASTM C 206, Type S, or special hydrated lime for masonry purposes, ASTM C 207, Type S.
- C. Sand Aggregate for Base Coats: ASTM C 897, natural or manufactured sand.
- D. Sand Aggregate for Finish Coat: ASTM C 897, natural or manufactured sand of size and gradation and color to provide stucco matching existing stucco.
- E. Reinforcement Fibers: Alkali-resistant, 1/2-inch-long, glass or polypropylene fibers complying with ASTM C 1116, specifically manufactured for reinforcing mixes containing Portland cement, and approved by Architect.
- F. Pigments: Inorganic oxides, alkali-resistant, non-fading, complying with ASTM C 979, and with a record of successful use in masonry materials containing cement and lime.
- G. Water: Clean, fresh, potable, and free from amounts of oils, acids, alkalis, organic matter, and other substances that might adversely affect installation, curing, and durability of stucco and accessories and from contaminants that may cause staining or efflorescence.

2.2 LATH AND ACCESSORIES

- A. Stainless Steel Expanded Metal Lath: Expanded metal lath of ASTM A 276 Type 304 stainless steel weighing 3.4 lbs. per sq. yd. and complying with ASTM C 847, except for the metal alloy. Provide stainless steel lath by AMICO, 3245 Fayette Ave., P.O. Box 3928, Birmingham, AL 35208 (800-366-2642), or approved equal.
- B. Metal Accessories: Provide stucco accessories of ASTM A 276 Type 304 stainless steel complying with ASTM C 1063 and ASTM C 841. Provide metal accessories by AMICO, 3245 Fayette Ave., P.O. Box 3928, Birmingham, AL 35208 (800-366-2642), or approved equal.
 - 1. Casing Beads, Corner Beads, and Control Joints: Fabricated from stainless steel, with expanded flanges of large-mesh diamond-metal lath allowing full stucco encasement.
- C. Tie Wire: ASTM A 276 Type 304 or Type 316 stainless steel, 18 gauge, minimum, complying with requirements of ASTM A 580.

2.3 ANCHORS AND FASTENERS

- A. General: Anchors and fasteners shall be of ASTM A 276 Type 304 or Type 316 stainless steel, unless specifically indicated otherwise, and of size and configuration as required to provide optimum firm, solid support as approved by Architect.
- B. Anchors for Attaching Lath to Masonry Substrate: Stainless steel self-threading screw anchors specifically designed for attaching elements to masonry, 1/4-inch diameter by length required to provide 1-3/4-inch embedment in masonry. Provide 410 Series Stainless Steel Tapcon Anchors with Hex Washer Head, distributed by Concrete Fasteners, 1231 East 26th Street, Cleveland, OH 44114, (216-357-7433), or approved equal.
- C. Washers: Stainless steel washers with inside diameter sized to fit anchor shaft and outside diameter sized to ensure that washer cannot pass through openings in diamond mesh lath.
- D. Spacers: Resilient spacers 1/4-inch thick and with a 1/2-inch maximum diameter as approved by Architect to support lath 1/4-inch in front of masonry substrate.

2.4 MISCELLANEOUS MATERIALS

- A. Bonding Agent for Bonding New Three-Coat Stucco to Brick Masonry: Polyvinyl acetate homopolymer bonding agent designed for bonding new stucco to substrate. Provide Weld-Crete Concrete Bonding Agent as manufactured by Larsen Products Corp., 8264 Preston Court, Jessup, MD 20794 (800-633-6668), or approved equal.
- B. Paint for Stucco: Comply with requirements of Section 099113 – “Exterior Painting.”

2.5 PROPORTIONS OF STUCCO MIXES

- A. General: Provide stucco with following proportions by volume. Use measuring equipment that allows proportions to be accurately measured and repeated.
- B. Proportions for Stucco Base Coats
 - 1. Binder: Mix in proportion of one (1) part Portland cement to one (1) part hydrated lime.
 - 2. First (Scratch) Coat Stucco: Mix in Proportion of one (1) part binder (above) to two and one half (2½) to four (4) parts sand with reinforcement fibers at manufacturer's recommended quantity.
 - 3. Second (Brown) Coat: Mix in Proportion of one (1) part binder (above) to three (3) to five (5) parts sand with reinforcement fibers at manufacturer's recommended quantity. (Use white cement, gray Portland cement, or a combination of white Portland cement and gray Portland cement as required to mix stucco matching color of existing portland cement skim coat.)
- C. Proportions for Finish Coat Stucco
 - 1. Binder: Mix in proportion of one (1) part Portland cement to one (1) part hydrated lime. (Use white cement, gray Portland cement, or a combination of white Portland cement and gray Portland cement as required to mix stucco matching color of existing portland cement skim coat. Adjust to achieve final color by adding pigments not to exceed 10 percent of weight of Portland cement.)
 - 2. Stucco: Mix in Proportion of one (1) part binder to one and one half (1½) to two (2) parts sand.

2.6 MIXING STUCCO

- A. General: Mix stucco ingredients thoroughly in clean mixers or mortar boxes. Prevent contamination between batches.
 - 1. Do not prepare more stucco than can be applied within one hour.
- B. Quality Control: Only one worker on site shall prepare, measure, and mix stucco ingredients (dry cement, lime, sand, and pigment) for approved tinted stucco work to prevent color inconsistencies between batches. Same worker shall mix batches for samples and mock-ups.
- C. Consistency: Add only sufficient liquid to provide workable mix for scratch and brown coats.
- D. Finish Coat: Contractor may provide site-mixed finish coat or factory prepared and packaged finish coat meeting requirements of this Section.
 - 1. Color and Texture: Finish coat shall match texture and color of cleaned existing portland cement stucco skim coat and shall be as approved by the Architect.
 - a. Color: Achieve color primarily by blending white and gray Portland cement and using appropriately colored aggregate. Adjust to achieve final color by adding pigments not to exceed 10 percent of weight of Portland cement.
 - 2. Site-Mixed Finish Coat: Mix finish coat to comply with proportions and mixing requirements specified herein.
 - 3. Factory-Supplied Finish Coat: Provide factory-mixed finish coat meeting ingredient and proportion requirements specified herein and approved by Architect.

- a. Factory-supplied finish coat shall not contain any acrylic or latex admixtures or any other ingredients not specifically specified herein and approved by Architect.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordination: Sequence stucco restoration properly with the installation and protection of other work, so that neither stucco nor other work will be damaged by installation of the other.
- B. Protection: Protect adjoining surfaces before work begins.
- C. Thickness of Stucco: Provide stucco coats of at least minimum thickness required by specifications of the Portland Cement Association, Bulletin No. P 160B-2, latest edition, and as indicated on Drawings and specified herein. Adjust thicknesses as required to ensure plumb and square surfaces in plane with adjacent plasterwork and sharp, straight arrises.
 - 1. Scratch Coat: 3/8 inch thick
 - 2. Brown Coat: 3/8 inch thick
 - 3. Finish Coat: 1/4 inch thick
- D. Curing: Cure stucco coats to conform to moist curing methods specified by ANSI A42.2 and to comply with requirements of ASTM C 926. Protect each coat from extremes in weather to provide full strength and uniform shrinkage.
 - 1. Moist-cure scratch coat 48 hours.
 - 2. Moist-cure brown coat for 48 hours.
 - 3. Allow brown coat to cure 7 days.

3.2 PREPARATION FOR STUCCO PATCHING – FULL DEPTH

- A. Removal of Deteriorated Stucco: Remove deteriorated sections of stucco, including all stucco that is not soundly adhered to substrate. Ensure that remaining stucco is soundly adhered to substrate. Slightly undercut edges of areas from which stucco has been removed to provide a slight dovetail. Clean substrate free of loose mortar, grout, dirt, and other contaminants to provide clean, sound substrate for stucco application.
 - 1. Point joints in brick backup masonry where mortar is missing and where mortar is deteriorated to comply with requirements of Section 04 05 15 – Masonry Pointing to ensure sound uniform substrate for stucco application.

3.3 PREPARATION FOR STUCCO PATCHING – TOP COAT

- A. Removal of Deteriorated Top Coat: Remove deteriorated sections of stucco top coat. Ensure that remaining top coat is soundly adhered to basecoats.
- B. Cleaning: Clean substrate free of dirt and other contaminants to provide clean, sound substrate for application of patching material.

3.4 STUCCO PATCHING APPLICATION

- A. General Application Requirements
 - 1. Provide consistent mixes and mix materials thoroughly.
 - 2. Keep trowels and equipment clean.
 - 3. Work with a “wet” joint. Do not wet with water but with soft material. Material is no longer wet if the surface has started to dry.
 - 4. Carry stucco coats to completion without interruption or delay for each panel or building element.
 - 5. Clean existing metal lath to be reused free of existing plaster and rust. Replace deteriorated lath with new lath and supporting elements as required to provide secure, sound substrate.
- B. Bonding Agent: Apply bonding compound on stucco and masonry surfaces to be patched in strict accordance with manufacturer’s recommendations.
- C. Scratch Coat Application
 - 1. Apply with sufficient material and force to fill all spaces.
 - 2. Score the surface to receive the brown coat.
 - 3. Moist cure fresh scratch coat for 48 hours.
- D. Brown Coat Application
 - 1. Do not apply brown coat sooner than 48 hours after installation of scratch coat or until scratch coat is thoroughly dry, whichever is longer.
 - 2. Apply brown coat to the scratch coat.
 - 3. Bring out to grounds, straighten to a true surface, and leave sufficiently rough to assure adequate bond of subsequent coat.
 - 4. Moist cure fresh brown coat for 48 hours.
 - 5. Allow brown coat to cure for seven days.
- E. Finish Coat Application
 - 1. Do not apply finish coat sooner than seven days after the installation of brown coat.
 - 2. Apply finish coat to a texture and color matching existing portland cement stucco skim coat. Make final trowelling to tighten up surfaces in one direction only.
- F. Protection of Applied Stucco: Protect scratch, brown, and finish coats from freezing and from too-rapid and uneven drying.
- G. Defective Work: Work showing variations in surface finish appearance due to pause in work, change in workmanship, or difference in mix color and work with cracks or other defects will be rejected by the Architect. Contractor shall remove rejected work, properly prepare substrate, and provide new work complying with requirements of this Section at no additional cost to Owner.
- H. Cleaning and Repair: Remove stucco from adjacent materials to remain after installation of each coat. Repair or replace damaged and defaced materials to remain at Architect’s direction at no additional cost.

3.5 CLEAN-UP

- A. In addition to other requirements for cleaning, immediately upon completion of this portion of the Work visually inspect adjacent surfaces and remove spilled and splashed stucco and stains from stucco.

END OF SECTION 09 24 23

SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Sound batt insulation at interior partitions.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
2. Section 092216 "Non-Structural Metal Framing" for nonstructural steel framing and suspension systems that support gypsum board panels.
3. Section 093013 "Ceramic Tiling" for tile backing panels installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Health Product Declaration (HPD): Provide documentation indicating that manufacturer has screened and publicly provided ingredient disclosure to 1000 ppm and has developed an action plan to mitigate known hazards.
3. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet

Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 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.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or 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 board and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

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 on Drawings in accordance with ASTM E119; tested by a qualified testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E90 and classified in accordance with ASTM E413; tested by a qualified testing agency.
- C. Verify ceiling and wall materials comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 GYPSUM BOARD, GENERAL

- A. Product Data: Verify materials were manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. Size: Provide panel products in maximum lengths and widths available that will minimize joints in each area and that correspond with support system specified or indicated on Drawings.

2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Abuse Resistant Type X: ASTM C1396/C1396M, tested in accordance with ASTM C1629/C1629M; manufactured to have increased durability and fire-resistive capability.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CertainTeed; SAINT-GOBAIN**
 - b. **Gold Bond Building Products, LLC provided by National Gypsum Company**
 - c. **USG Corporation**
 2. Thickness: 5/8-inch.
 3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 6. Long Edges: Tapered.
 7. Application: All partitions unless noted otherwise.
- B. Gypsum Board, Mold/Moisture-Resistant, Abuse-Resistant Type X: ASTM C1396/C1396M, tested in accordance with ASTM C1629/C1629M.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CertainTeed; SAINT-GOBAIN**
 - b. **Gold Bond Building Products, LLC provided by National Gypsum Company**
 - c. **USG Corporation**
 2. Thickness: 5/8-inch.
 3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 6. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
 7. Long Edges: Tapered.
 8. Application: All corridor and vestibule partition surfaces.
- C. Lightweight Gypsum Board, Type C: ASTM C1396/C1396M; manufactured to have increased fire-resistive capability and to be lighter in weight than traditional gypsum board of same thickness.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. **CertainTeed; SAINT-GOBAIN**
 - b. **Gold Bond Building Products, LLC provided by National Gypsum Company**
 - c. **USG Corporation**
 2. Thickness: 5/8-inch.
 3. Long Edges: Tapered.
 4. Application: Ceilings.
- D. Trim for Interior Gypsum Board: ASTM C1047.
1. Material: Galvanized-steel sheet or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.

2. Shapes: including but not limited to the following, as required:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Curved-Edge Cornerbead: With notched or flexible flanges.
 - g. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

E. Joint Treatment Materials for Interior Gypsum Board: Comply with ASTM C475/C475M requirements.

1. Joint Tape: Paper.
2. Joint Compound: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - a. Mold-Resistant Joint Compound: Use mold-resistant formulations with mold-resistant gypsum board products.
 - b. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - c. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
 - d. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - e. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - f. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.5 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 in writing by manufacturer for directly adhering gypsum panels to continuous substrate.
 1. Verify adhesives have a VOC content of 50 g/L or less.
- C. Steel Drill Screws: ASTM C1002 unless otherwise specified or indicated on Drawings.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers as follows:
 1. **Basis-of-Design product: subject to compliance with requirements, provide Rockwool; Safe-n-Sound at dimensions to fully fill study cavity; or approved equal.**
 2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 3. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
 - 1. Product Data: Verify architectural sealant has a VOC content of 250 g/L or less.
- F. Primer: As recommended in writing by texture finish manufacturer.

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

3.2 INSTALLATION AND FINISHING OF GYPSUM BOARD, GENERAL

- A. Comply with ASTM C840 requirements.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form expansion (control) joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 requirements 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. 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 on Drawings.
- 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise specified or indicated on Drawings 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 on Drawings or required by fire-resistance-rated assembly.
- 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

- 1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over studs or furring members and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated on Drawings or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- 2. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

C. Application of Laminating Adhesive 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.

D. Trim for Interior Gypsum Board: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim in accordance with manufacturer's written instructions.

- 1. Cornerbead: Install at outside corners.
- 2. Expansion (Control) Joint: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.

- E. Joint Treatment Materials for Interior Gypsum Board: Treat joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare panel surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - 1. Prefill open joints and damaged surface areas.
 - 2. Apply joint tape over panel joints, except for trim products specifically indicated as not intended to receive tape.
- F. Finish interior gypsum board panels to comply with levels indicated below and in accordance with ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated on Drawings.
 - 2. Level 2: Not used.
 - 3. Level 3: Not used.
 - 4. Level 4: At all Lower-Level surfaces that will be exposed to view, unless otherwise indicated.
 - 5. Level 5: At all Entry Level surfaces that will be exposed to view unless otherwise indicated.

3.4 PROTECTION

- A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation and finishing.
- 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 have gotten 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.

END OF SECTION 092900

SECTION 093013

CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor and wall tile.
2. Thresholds.
3. Tile backing panels, crack isolation membranes, setting materials, and grout materials.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
2. Section 092900 "Gypsum Board" for tile backing units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces. Show thresholds.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection or shade variation.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch lengths.

E. Sustainable Design Submittals:

1. Health Product Declaration: For each product.
2. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Product Data: For adhesives, indicating VOC content.
7. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
8. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

- A. Sustainability and LEED Standards:
1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 4. Forest Stewardship Council (FSC)
 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
 6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to

7. Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product, including product use classification.
- C. Product Test Reports:
 - 1. Tile-setting and -grouting products.
 - 2. Certified porcelain tile.
 - 3. Slip-resistance test reports from qualified independent testing agency.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Build mockup of each type of wall tile installation, include outside and inside corners.
 - 3. Build mockup of floor tile to wall tile transition.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 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.

1.10 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.

1.11 WARRANTY

- A. Provide Manufacturer's standard 25-year systems warranty for grout materials, setting materials, and waterproofing/crack isolation membrane.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Tile: Obtain tile 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. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Stone thresholds.
 - 2. 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.
 - 1. Provide tile complying with Standard Grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard

with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 PORCELAIN TILE

A. Floor and wall tile.

1. Certification: Tile certified by the Porcelain Tile Certification Agency.
2. Basis-of-Design Product: Subject to compliance with requirements, provide **Mosa, Global Collection** floor and wall tile.
 - a. Location: All restrooms:
 - 1) **Floor Selection: 75225, 12 x 12.**
 - 2) **Wall Selection: 16760, 6 x 6.**
3. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
4. Grout Color: As selected by Architect from manufacturer's full range.
5. 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. **Cove Base: Manufacturer's designation SP, size 6 x 12, finish to match floor tile.**

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes and as indicated on Drawings.
- B. Slate Thresholds: ASTM C629-3, with a minimum abrasion resistance of 10 in accordance with ASTM C1353/C1353M or ASTM C241/C241M and with honed finish.

2.5 TILE BACKING PANELS

- A. Refer to Section 092900 – Gypsum Board.

2.6 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Crack Isolation Membrane, Polyethylene Sheet: Polyethylene faced on both sides with polyester fabric.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Schluter Systems L.P.; Ditra Uncoupling Membranes** or comparable product by one of the following:
 - a. Laticrete International, Inc.
 - b. MAPEI Corporation
 - 2. Provide accessories as recommended by Manufacturer for a complete installation.

2.7 SETTING MATERIALS

- A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete International, Inc.: LATICRETE 254 Platinum** or comparable product by one of the following:
 - a. ARDEX Americas
 - b. MAPEI Corporation
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.15.

2.8 GROUT MATERIALS

- A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less .
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete International, Inc.: SPECTRALOCK Pro Premium** or comparable product by one of the following:
 - a. ARDEX Americas
 - b. MAPEI Corporation

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with

surface finish requirements in ANSI A108.01 for installations indicated.

- a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. 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.
 4. 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 PREPARATION

- A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- E. Substrate Flatness:
1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
 2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- C. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
 2. 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.
- D. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors consisting of tiles 8 by 8 inches or larger.
 2. 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.
 3. 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.
 4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
 5. 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 use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - a. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - b. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
- F. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. Do not extend crack isolation membrane under thresholds set in improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.
- G. Grout Sealer: Apply grout sealer to grout joints in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 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 in accordance with tile and grout manufacturer's written instructions. 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 with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. TCNA F125-Full Installation: Thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: Floor.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - d. Crack Isolation Membrane: Polyethylene sheet.
 - e. Joint Width: 3/16 inch.
- B. Interior Floor Installations, Wood Subfloor:
 - 1. TCNA F148-Full Installation: Thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: Floor.
 - b. Thinset Mortar: Improved modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - d. Crack Isolation Membrane: Polyethylene sheet.
 - e. Joint Width: 3/16 inch.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. TCNA W242 Installation: Organic adhesive on gypsum board.
 - a. Ceramic Tile Type: Wall.
 - b. Grout: Water-cleanable epoxy grout.

- c. Joint Width: As required to align with floor joints.

END OF SECTION 093013

SECTION 096513

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic rubber base.
2. Thermoplastic rubber stair treads and risers.
3. Resilient transition strips.

B. Related Requirements:

1. Section 096543 "Linoleum Flooring" for tile and sheet linoleum flooring.

1.2 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 instructions for each type of substrate.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

C. Sustainable Design Submittals:

1. Environmental Product Declaration (EPD): For each product.
2. Health Product Declaration (HPD): For each product.
3. Third-Party Certifications: For each product.
4. Third-Party-Certified Life-Cycle Assessment: For each product.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet

Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- ##### A. Product Test Reports: For resilient base and accessory products, for tests performed by a qualified testing agency.

1.6 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 or more than 90 deg F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, 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 or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Verify flooring products comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 RESILIENT BASE

- A. Thermoplastic Rubber Base:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Tarkett USA; Johnsonite Dura-Cove Rubber base (Type TP)** or comparable product by one of the following:
 - a. Forbo Flooring Systems
 - b. Roppe Corporation; Roppe Holding Company
 - 2. Classification: ASTM F1861, Type TP, Group 1..
 - 3. Thickness: 0.125 inch.
 - 4. Height: 4 inches.
 - 5. Profile: Cove base at resilient flooring locations. Straight base at carpet tile locations.

6. Lengths: Coils in manufacturer's standard length.
7. Outside Corners: Job formed or preformed.
8. Inside Corners: Job formed or preformed.
9. Colors: As selected by Architect from manufacturer's full range; Basis of Design selection "29 Moon Rock" to be reviewed and confirmed in Submittal review.

2.3 RESILIENT STAIR ACCESSORIES

A. Rubber Stair Treads:

1. Manufacturers: Subject to compliance with requirements, provide Tarkett USA; Johnsonite Angle Fit Rubber Stair Treads or comparable product by one of the following:
 - a. Forbo Flooring Systems
 - b. Roppe Corporation; Roppe Holding Company
2. Classification: ASTM F2169, Type TS, Group 1.
3. Tread Type: Raised Round Surface.
4. Nosing Style: Square.
5. Nosing Height: 2 inches
6. Thickness: 0.095 inch and tapered to back edge.
7. Size: Lengths and depths to fit each stair tread in one piece.
8. Colors: As selected by Architect from manufacturer's full range; Basis of Design selection "29 Moon Rock" to be reviewed and confirmed in Submittal review.
9. Locations: Entry Stair 112.

C. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer who produced treads and recommended by manufacturer for installation with treads.

1. Classification: ASTM F-1861, Type TP, Group 1.
2. Style: Coved toe.
3. Size: Lengths and heights to fit each stair riser in one piece.
4. Thickness: 1/8 inch.

D. Stringers: Smooth, flat; produced by same manufacturer who produced treads and recommended by manufacturer for installation with treads.

1. Classification: ASTM F-1861, Type TP, Group 1.
2. Height: 10".

E. Landing Tile: Match Corridor 001 flooring.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended in writing by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Verify adhesive complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

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 in accordance with manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. 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.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 INSTALLATION OF RESILIENT BASE

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 INSTALLATION OF RESILIENT STAIR ACCESSORIES

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 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.
- C. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply **two** coat(s) or per manufacturer's recommendation if specified.
- D. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096513

SECTION 096543
LINOLEUM FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Linoleum tile flooring.
2. Linoleum sheet flooring.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. Section 035416 "Hydraulic Cement Underlayment" for prepping existing floor structure.
3. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with linoleum flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to linoleum flooring installation including, but not limited to, the following:
 - a. Delivery, storage, and handling procedures.
 - b. Ambient conditions and ventilation procedures.
 - c. Subfloor preparation procedures.
 - d. Pattern.
 - e. Edge conditions adjacent to carpet tile.

1.3 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 instructions for each type of substrate.

B. Shop Drawings: For each type of linoleum flooring.

1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

- C. Samples: For each exposed product and for each color and pattern specified in manufacturer's standard size, but not less than 6-by-9-inch sections.
- D. Sustainable Design Submittals:
 - 1. Product Data: For installation adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.
 - 3. Laboratory Test Reports: Verify compliance with VOC emissions evaluation.
 - 4. Environmental Product Declaration (EPD): For each product.
 - 5. Health Product Declaration (HPD): For each product.
 - 6. Third-Party Certifications: For each product.
 - 7. Third-Party-Certified Life-Cycle Assessment: For each product.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 - 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 - 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS,

third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

B. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for linoleum flooring installation and seaming methods indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For linoleum flooring, for tests performed by a qualified testing agency.

B. Qualification Data: For Installer.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of linoleum flooring.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile Flooring: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
2. Sheet Flooring: Furnish not less than 10 linear ft. for every 500 linear ft. or fraction thereof, in roll form and in full roll width for each type, color, and pattern of sheet flooring installed.

1.9 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups as indicated on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.
 - 1. Tile Flooring: Store on flat surfaces.
 - 2. Sheet Flooring: Store rolls upright.

1.11 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring during the following periods:
 - 1. 72 hours before installation.
 - 2. During installation.
 - 3. 72 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 or more than 95 deg F.
- C. Close spaces to traffic during flooring installation.
- D. Close spaces to traffic for 72 hours after flooring installation.
- E. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

- B. Verify flooring products comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 LINOLEUM FLOORING

A. Linoleum Tile Flooring:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Forbo Flooring Systems
2. Basis-of-Design Product: Subject to compliance with requirements, provide **Forbo Flooring, MCT** or comparable product.
3. Classification: ASTM F2195, Type I, linoleum floor tile with fibrous backing.
4. Nominal Floor Tile Size: Manufacturer's standard.
5. Thickness: .08 in.
6. Colors and Patterns: Initial selections will be confirmed or modified by Architect during submittal process.
 - a. RT-1: MCT-629 "Eiger"
 - b. RT-2: MCT-3280 "Misty"
 - c. RT-3 (Accent Tile):
 - 1) Community Room 014: MCT-3278 "Mandarin"
 - 2) Staff Lounge 004: MCT-3238 "Laguna"
 - 3) Children's Lunch Room 003: MCT-3251 "Lemon Zest"

B. Linoleum Sheet Flooring:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Forbo Flooring Systems
2. Basis-of-Design Product: Subject to compliance with requirements, provide **Forbo Flooring, Marmoleum Real** or comparable product.
3. Classification: ASTM F2034, Type I, linoleum sheet with backing.
4. Roll Size: In manufacturer's standard length.
5. Thickness: .13 in.
6. Colors and Patterns: Initial selections will be confirmed or modified by Architect during submittal process.
 - a. RF-1: 2629 "Eiger"
 - b. RF-2: 3146 "Serene Grey"

2.3 ACCESSORY MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.
 - 1. Verify adhesive complies with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by flooring manufacturer.

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 flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of linoleum flooring products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates in accordance with flooring manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare in accordance with ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. 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. 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. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate. Install hydraulic cement underlayment as required to provide suitable substrate for flooring installation.
- D. Do not install linoleum flooring until materials are the same temperature as space where they are to be installed.
 - 1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.3 INSTALLATION OF LINOLEUM FLOORING, GENERAL

- A. Comply with manufacturer's written instructions for installing linoleum flooring.
- B. Scribe and cut linoleum flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on linoleum flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- E. Install linoleum flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- F. Adhere linoleum flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- G. Heat-Welded Seams: For seamless installation, comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 INSTALLATION OF LINOLEUM TILE FLOORING

- A. Lay out linoleum tile flooring from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to

avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay floor tiles in pattern indicated.

B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles with grain direction alternating in adjacent floor tiles (basket-weave pattern) and in pattern of colors and sizes indicated.

3.5 INSTALLATION OF LINOLEUM SHEET FLOORING

A. Unroll linoleum sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out linoleum sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.
5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.

B. Perform the following operations immediately after completing linoleum flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect linoleum flooring from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from linoleum flooring surfaces before applying liquid floor polish.

1. Apply three coat(s).

E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

END OF SECTION 096543

SECTION 096723
RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on interior concrete floors.

1.2 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.
- C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Sustainable Design Submittals:
 - 1. Product Data: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - 2. Product Data: For flooring materials, including printed statement of VOC content.
- E. Samples: For each type of coating system and in each color and gloss of topcoat indicated.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
- 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 - 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

- 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
- 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
- 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
- 4. Forest Stewardship Council (FSC)
- 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
- 6. California Air Resources Board (CARB) 2007 *Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products*, Phase 2
- 7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- A. Maintenance Data.
- B. Manufacturer's Standard Warranty

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Contractor shall have completed at least 10 projects of similar size and complexity.
 - B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, water proofing membranes, hardening agents, grouting coats, broadcast aggregates and topcoats through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
 - C. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
 1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
 - B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
 - C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
- 1.8 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.
 1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.
 - B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
 - C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.
 - D. Concrete substrate shall be properly cured. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.
- 1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements, provide Stonsheild SLT as manufactured by Stonhard, Inc. or comparable product by of the following:
 - 1. Dexotex.
 - 2. Sherwin Williams.
 - 3. Dur-A-Flex.

2.2 RESINOUS FLOORING SYSTEM

- A. System Characteristics:
 - 1. Wearing Surface: Standard or medium.
 - 2. Integral Cove Base: 6 inches
 - 3. Overall System Thickness: ¼”.
 - 4. Color and Pattern: Architect to select from manufacturer’s standard range.
- B. System Components: Manufacturer’s standard components that are compatible with each other and as listed below:
 - 1. Primer
 - a. Material Basis: Stonhard Standard Primer
 - b. Resin: Epoxy
 - c. Formulation Description: (2) two component, 100 percent solids, UV stable.
 - d. Application Method: Squeegee and roller.
 - e. Number of Coats: (1) one.
 - 2. Undercoat:
 - a. Material Basis: Stonshield undercoat.
 - b. Resin: Epoxy
 - c. Formulation Description: (2) two-component, 100% solids, UV Stable.
 - d. Type: Clear.
 - e. Finish: Gloss.
 - f. Number of Coats: one.
 - 3. Broadcast Media:
 - a. Material Basis: Stonshield quartz aggregate
 - b. Type: pigmented.
 - c. Finish: standard.
 - d. Number of Coats: one.
 - e. Color: Flagstone.
 - 4. Sealer:

- a. Material Basis: Stonkote CE4.
 - b. Resin: Epoxy
 - c. Formulation Description: (2) two-component, 100% solids, UV Stable.
 - d. Type: Clear.
 - e. Finish: Gloss.
 - f. Number of Coats: one.
 - g. Texture level: Standard or medium.
- C. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - 1. Tensile Strength: 1,600 psi per ASTM C307
 - 2. Flexural Strength: 4,000 psi per ASTM C580
 - 3. Flexural Modulus of Elasticity: 1.0×10^6 psi per ASTM C580
 - 4. Hardness: 85 to 90 per ASTM D2240, Shore D
 - 5. Impact Resistance: > 160 in./lbs. per ASTM D2794
 - 6. Abrasion Resistance: 0.06 gm max. weight loss per ASTM D 4060, CS-17
 - 7. Flammability: Class 1 per ASTM E-648.
 - 8. Thermal Coefficient of Linear Expansion: 1.4×10^{-5} in./in. °F
 - 9. Water Absorption: 0.1% per ASTM C 413
 - 10. VOC Content per ASTM D2369:
 - a. Stonshield Undercoat – 34 g/l
 - b. Stonkote CE4 – 34 g/l
 - 11. Cure Rate @ 77°F/25°C: 12 hours foot traffic, 24 hours normal operations

2.3 ACCESSORY MATERIALS

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

PART 3 - EXECUTION

3.0 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring. Prior to epoxy installation:
 - 1. Mechanically prepare substrates as follows:
 - a. Includes use of a scabbler, scarifier or shot blast machine for removal of bond inhibiting materials such as curing compounds or laitance.
 - b. Hand diamond grind near walls and obstructions.
 - c. 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 recommendations.
 3. Verify that concrete substrates meet the following requirements:
 - a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 85 percent.
 - b. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 6 lb of water/1000 sq. ft. of slab in 24 hours.
 - c. Perform moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- D. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

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, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- D. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 TERMINATIONS

- A. Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.
- B. Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

- C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.4 JOINTS AND CRACKS

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

3.5 CLEANING, PROTECTING, AND CURING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General contractor is responsible for cleaning prior to inspection.

END OF SECTION 096723

SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carpet tile.

1.2 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. Samples for Verification: Actual sample of finished products 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- long Samples.

C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

D. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Health Product Declaration (HPD): Provide product's Material Health Certificate or Cradle to Cradle certification.
3. Declare, Action Submittals: Provide product's Declare product label, designated as "Red List Free," Declare or Living Building Challenge (LBC) compliant to 0.1 percent.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.
6. Facts, Action Submittals: Provide product's Facts - NSF/ANSI 336, "Sustainability Assessment for Commercial Furnishings Fabric," certification.
7. Life-Cycle Impact-Reduction Action Plan, Action Submittals: Provide product-specific, Life-Cycle Assessment (LCA) complying with EN 15804 or ISO 21930.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- B. Qualification Statements: For Installer.
- C. Sample Warranties: For carpet tile.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles. 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.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner 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 no fewer than 10 full-size units.

1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups as indicated on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.10 FIELD CONDITIONS

- A. Comply with 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 in writing by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 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. Failures include, but are not limited to, the following:
 - a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
 - b. Loss of tuft-bind strength.
 - c. Excess static discharge.
 - d. Delamination.
 - e. Dimensional instability.
 - 3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis-of-Design (BOD) Product: Subject to compliance with requirements and to be reviewed and confirmed in Submittal review, provide products from **ShawContract**, or comparable product by one of the following:
 - 1. Interface
 - 2. Tarkett USA
- B. Product Code:
 - 1. CPT-1: 5T265 "Dream Tile" Kindred Collection
 - 2. CPT-2: 5T265 "Dream Tile" Kindred Collection
 - 3. CPT-3:
 - a. Children's Reading Room 105: 59368 Tru Colours Tile
 - b. Adult/Teem Reading Room 105: 59368 Tru Colours Tile
 - c. Staff Workroom 108, Meeting Room 109: 5T265 "Dream Tile" Kindred Collection
- C. Color: Initial selections will be confirmed or modified by Architect during submittal process.
 - 1. CPT-1: 48111 "Warmth"
 - 2. CPT-2: 48979 "Insight"
 - 3. CPT-3:

- a. Children's Reading Room 105: 68668 "Paprika"
 - b. Adult/Teem Reading Room 105: 68851 "Regal Red"
 - c. Staff Workroom 108, Meeting Room 109: 48323 "Comfort"
- D. Pattern: n/a
- E. Fiber Type: Nylon.
- F. Pile Characteristic: Multi-Level Pattern Loop.
- G. Density: 6680 oz/cub. yd.
- H. Pile Thickness: .146 for finished carpet tile in accordance with ASTM D6859.
- I. Stitches: 9 per inch.
- J. Gage: 1/12 inch.
- K. Backing: Manufacturer's standard "EcoWorx Tile".
- L. Size: 24 by 24 inches.
- M. Applied Treatments:
 - 1. Soil-Resistance Treatment: Manufacturer's standard treatment "Protekt 2".
- N. Sustainable Design Requirements:
 - 1. Verify flooring products comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- O. Performance Characteristics:
 - 1. Texture Appearance Retention Rating (TARR): Severe traffic, 3.5 minimum in accordance with ASTM D7330.
 - 2. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
 - 3. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
 - 4. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.
 - 5. Electrostatic Propensity: Less than 3.5 kV in accordance with AATCC 134.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.

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

3.2 PREPARATION

- A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch 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 CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Installation Pattern: Manufacturer's standard "Monolithic" installation. Directionality as indicated on Drawings.
- D. Maintain dye-lot integrity. Do not mix dye lots in same area.
- E. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- F. 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 in writing by carpet tile manufacturer.

- G. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- I. 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 in writing 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 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 098436

SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Sound-absorbing ceiling panels in Staff Workroom 108 and Meeting Room 109.
- B. Related Requirements:
 - 1. Section 092216 "Non-Structural Metal Framing" for mounting struts.
 - 2. Section 265100 "Interior Lighting" for integrated lighting.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include panel edge, core material, and mounting indicated.
- B. Sustainable Design Submittals:
 - 1. Third-Party Certifications: For each product.
 - 2. Third-Party Certified Life Cycle Assessment: For each product.
 - 3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
- C. Shop Drawings: For unit assembly and installation.
 - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
 - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.
- D. Samples for Verification: For the following products:
 - 1. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
 - 2. Core Material: 12-inch- square Sample at corner.
 - 3. Mounting Devices: Full-size Samples.
 - 4. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of unit.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and 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.

1.8 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. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

1.9 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. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical

products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.2 STRUT-MOUNTED SOUND ABSORBING CEILING UNITS

- A. Locations: as indicated on Drawings in Entry level.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **Arktura; SoundBar 100% PET** sound absorbing ceiling panel or approved equal.
 1. Composition: 100% PET plastic containing at least 60% post-consumer content.
 2. Thickness: 12mm.
 3. Edge Profile: Square; 4 x 6 inches.
 4. Size: As indicated on Drawings.
 5. Pattern: Solid.
 6. Color: BOD SoftSound Essentials "Kiwi" to be confirmed by architect during submittal process.
 7. Mounting: As indicated on Drawings.
 8. NRC: 0.50.

2.3 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. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch 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 edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/8 inch .
- C. Variation of Joint Width: Not more than 1/16 inch wide from hairline in 48 inches, noncumulative.

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 098436

SECTION 099113

EXTERIOR PAINTING AND COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Ferrous metal.
 - 2. Non-ferrous metal.
 - 3. Galvanized metal.
 - 4. Masonry.
 - 5. Stucco.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and each color and gloss of topcoat.

1.3 TESTING

- A. General: Before beginning stucco painting work or preparing mock-ups, test silicate mineral primers on sample areas of stucco to determine most appropriate product and method. Do not proceed with stucco painting mock-ups until Architect has approved results of testing.
 - 1. Locate tests as directed by Architect.
 - 2. Size of Test Panels
 - a. Applying primer on stucco: 3 sq. ft. for each primer.
 - 3. Notify Architect 48 hours prior to start of testing.
 - 4. Provide Architect opportunity to be present during testing. Architect will monitor testing in progress at their discretion. Architect can reject test panels not performed in their presence.
 - 5. Use crew that will execute work and follow requirements of this Section.
 - 6. Stop testing and remove product from surface immediately using appropriate solvent upon observing any adverse effect to substrate.
- B. Test the following silicate mineral primers to determine the best texture match to stucco:
 - 1. KEIM Soldalit Grob
 - 2. KEIM Contact Plus Grob Sol-Silicate Filing Primer and Block Filler

1.4 MOCK-UPS

- A. General: Before beginning exterior painting and coatings work, prepare mock-ups to provide standards for work of this Section. Do not proceed with exterior painting and coatings work until Architect has approved mock-ups.

1. Locate mock-ups as directed by Architect.
2. Notify Architect 48 hours prior to start of each mock-up.
3. Provide Architect opportunity to be present during mock-ups. Architect will monitor mock-ups in progress at their discretion. Architect can reject mock-ups not performed in their presence.
4. Use crew that will execute the work and follow requirements of this Section.
5. Repeat mock-ups as necessary to obtain Architect's approval.
6. Protect approved mock-ups to ensure that they are without damage, deterioration, or alteration at time of Substantial Completion.
7. Approved mock-ups in undamaged condition at time of Substantial Completion may be incorporated into the Work.
8. Approved mock-ups will represent minimum standards for painting and finishing. Subsequent painting and finishing work that does not meet standards of approved mock-ups will be rejected.

B. Prepare the Following Mock-Ups

1. Primer on stucco: One location, 64 sq. ft., minimum.
2. Stucco surfaces: One location, 64 sq. ft., minimum.
3. Masonry water table: One location, 64 sq. ft., minimum.
4. Ferrous metal security fence at Mechanical Room Enclosure: One location, 2 LF, minimum
5. Masonry at mechanical enclosure: One location, 16 sq. ft., minimum

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).

- b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
- 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
- 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.7 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. 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.

1.8 REQUIREMENTS FOR COATING APPLICATION

- A. General: Comply with specified requirements and manufacturer's recommendations concerning temperature requirements for products specified herein. In case of conflict, the more stringent requirements shall govern.
- B. Temperature and Humidity: Comply with material manufacturer's written instructions for application conditions.
 - 1. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above dew point; or to damp or wet surfaces.
- C. Substrate
 - 1. Substrate shall be dry. Do not apply coatings to damp or wet surfaces. Do not apply when precipitation is expected within 48 hours of application.
 - 2. Do not apply coatings when the moisture content of the substrate exceeds coating manufacturer's recommendations or the level specified herein. Measure moisture content using a properly calibrated electronic moisture meter.
 - a. Masonry: 12 percent.
 - b. Wood: 15 percent.
 - c. Plaster: 12 percent.
 - 3. Masonry substrates to receive silicate paints shall be in shade or shadow. Do not apply coatings to substrate receiving direct sunlight.

4. Test masonry, plaster surfaces, and surfaces from which paint has been removed using alkaline paint strippers for alkalinity to ensure compliance with conditions for optimum coating application recommended by coating manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Paint Products: Subject to compliance with requirements, provide the product listed in the paint schedules The Sherwin-Williams Company; www.sherwin-williams.com; or an approved equal product by one of the following manufacturers:
 1. Benjamin Moore & Company.
 2. PPG Industries, Inc.
- B. High Performance Coatings: Subject to compliance with requirements, provide products by Tnemec, 6800 Corporate Drive, Kansas City, Missouri, 64120, 1 (816) 483-3400, www.tnemec.com, or approved equal.
- C. Silicate Mineral Paint Coatings for Painted Masonry: Provide products by KEIM Mineral Coatings of America, Inc. 3935 Perimeter West, Suite 100, Charlotte NC 28214, or approved equal.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List.
- B. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Paint Colors: As selected by Architect from manufacturer's full range.
- E. High Performance Coating Color: At existing site fence – PPR Standard Flat Black

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 Manual" applicable to substrates and paint systems indicated.
- B. 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.
- C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal"
- D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- F. Stucco and Painted Masonry Substrates: Following coating removal complying with requirements of Section 09 01 10.15 – Paint and Coating Removal and repair of stucco complying with requirements of Section 09 24 23 - Stucco Restoration, fill gouges, scrapes, and indentations flush with existing plane of stucco. Rinse surfaces with solution of alcohol and water and wipe with clean cloths Plaster surfaces shall be dry, clean and free from grit, loose plaster, and surface irregularities before paint is applied.

3.3 PAINT APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Apply paints according to manufacturer's written instructions.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Scheduling Painting
 - 1. Curing of Stucco, Stucco Repairs, Plaster and Plaster Repairs: Allow stucco and plaster to cure for at least 28 days before painting. Allow longer cure if recommended by paint manufacturer for optimum performance of paint on plaster substrate.
 - 2. First Coat: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 3. Sufficient Time for Curing: Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause undercoat to lift or lose adhesion.

3.4 PAINTING MASONRY WITH SILICATE MINERAL PAINT

- A. General: Apply paints to maintain a wet edge and work to edges of masonry surfaces. Do not allow edge of painted area that does not correspond to edge of element being painted to dry out.
- B. Primer and First Finish Coat on Prepared Existing Stucco: Apply flood coat of primer using large brush or low-pressure spray, allowing primer to penetrate the stucco.
- C. First Finish Coat on New Stucco: Apply first finish coat to properly prepared stucco.
- D. Second Finish Coat on Stucco: Apply second finish coat to surfaces after first finish coat has cured, but not less than 24 hours following application of first finish coat.

3.5 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.

3.6 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 HIGH PERFORMANCE COATING SCHEDULE

- A. Ferrous Metal Unprimed – Security fence at Mechanical Enclosure:
 - 1. Primer: One coat of primer; Tnemec 90-97 @2.5-3.5 mil dry thickness
 - 2. First finish coat; Tnemec 161 @ 3.0-5.0 mil dry thickness. Color: Standard, match existing fence.
 - 3. Second finish coat; Tnemec 75 @ 2.0-3.0 mil dry thickness. Color: PPR Standard Black, match existing fence.
- B. Ferrous Metal Galvanized:
 - 1. First finish coat; Tnemec 161 @ 3.0-5.0 mil dry thickness, slightly tinted to another shade than the final finish coat. Color: Standard, match existing fence.
 - 2. Second finish coat; Tnemec 75 @ 2.0-3.0 mil dry thickness. Color: PPR Standard Black, match existing fence.

3.8 EXTERIOR PAINTING SCHEDULE

- A. Exterior Stucco Surfaces
 - 1. Primer (Coat 1): KEIM Soldalit Grob or Contact Plus Grob, as determined by testing and mockups.
 - 2. Finish Coats (Coat 2 and 3): KEIM Soldalit Sol-Silicate All Surface Mineral Finish.
- B. Exterior Unit Masonry at Water Table Surfaces to be Painted
 - 1. Primer (Coat 1): KEIM Soldalit Grob or Contact Plus Grob, as determined by testing and mockups.
 - 2. Finish Coats (Coat 2 and 3): KEIM Soldalit Sol-Silicate All Surface Mineral Finish.
- C. Exterior Masonry at Mechanical Enclosure
 - 1. 1. Primer (Coat 1): KEIM Soldalit Grob or Contact Plus Grob, as determined by testing and mockups.
 - 2. Finish Coats (Coat 2 and 3): KEIM Soldalit Sol-Silicate All Surface Mineral Finish.

END OF SECTION 099113

SECTION 099123
INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section Includes:
 - 1. Surface preparation and the application of paint and high-performance systems on the following substrates:
 - a. Concrete.
 - b. Steel and iron.
 - c. Galvanized metal.
 - d. Masonry.
 - e. Wood.
 - f. Gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, indicating VOC content.
- B. Samples: For each finish and for each color and texture required.
- C. Product Schedule: Include paint system, location, and substrate.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.

- c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
- d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
- 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
- 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
- B. Sustainability and LEED Standards:
 - 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 - 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 - 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 - 4. Forest Stewardship Council (FSC)
 - 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
 - 6. California Air Resources Board (CARB) 2007 *Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products*, Phase 2
 - 7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 400 g/L.
7. Pretreatment Wash Primers: 420 g/L.

C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Colors: As selected from manufacturer's standard color range. Multiple colors and accent colors may be selected. Number of colors or accent colors selected shall be at no additional cost to the Owner.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the product listed in the paint and coatings schedules **The Sherwin-Williams Company**; or an approved equal product by one of the following manufacturers:

- a. Benjamin Moore & Company.

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 work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
- 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. Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following, unless otherwise indicated:
 - 1. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - a. Paint the following work where exposed to view:
 - 1) Equipment, including panelboards.
 - 2) Piping, including uninsulated metal and plastic piping and insulating piping with paintable cover.
 - 3) Pipe hangers and supports.
 - 4) Conduit.
 - 5) Mechanical, electrical, and plumbing equipment that is indicated to have a factory-primed finish for field painting.
 - 6) Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 7) All previously painted items.
 - 8) Other items as directed by Architect.
 - b. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

- E. 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.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 PAINT SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

- 1. Waterborne Dryfall System:
 - a. Finish: Two coats Low VOC Waterborne Acrylic Dryfall, Flat B42-W00081

B. Steel, Galvanized, Sheet Metal, and Ferrous Metal Substrates:

- 1. Urethane system:
 - a. Primer: ProIndustrial Pro-Cryl Universal Primer
 - 1) Where corrosion is evident, provide KemBond Alkyd Primer.
 - b. Finish: Two coats ProIndustrial WB Alkyd Urethane Enamel, B53 series, semi-gloss

C. Exposed Structural Steel Substrates:

- 1. Alkyd System:
 - a. Primer: Recoatable Epoxy Primer (where required over existing steel and new steel factory primer)
 - b. Finish: Two coats ProIndustrial WB Alkyd Urethane Enamel, B53 series, semi-gloss

D. Wood Substrates:

- 1. Water-Based Epoxy System
 - a. Primer: ProMar 200 Zero VOC Primer
 - b. Finish: Two coats ProIndustrial Pre-Catalyzed Water-Based Epoxy, semi-gloss.

E. Gypsum Board and Plaster Substrates:

- 1. Water-Based Epoxy System
 - a. Primer: ProMar 200 Zero VOC Primer
 - 1) Existing, previously painted Substrates: Extreme Bond Primer
 - b. Wall Finish: Two coats ProIndustrial Pre-Catalyzed Water-Based Epoxy, eggshell.
 - c. Ceiling Finish: Two coats ProIndustrial Pre-Catalyzed Water-Based Epoxy, flat matte.

F. Masonry Substrates:

1. Water-Based Epoxy System
 - a. Primer: Extreme Bond Primer
 - b. Finish: Two coats ProIndustrial Pre-Catalyzed Water-Based Epoxy, eggshell.

3.4 PAINT COLOR SCHEDULE

- A. All color selections to be made by Architect from manufacturer's full available range. Colors to include base colors for all materials, and accent colors for walls (up to 10 distinct accent colors) at locations as directed by Architect. Refer to Drawings for application of paint colors and accents and coordinate final location of all colors and accents in field prior to installation.
- B. Basis-of-Design (BOD) Products: Products, colors and locations to be confirmed by the architect through the submittal process.
- C. Ceilings:
 1. PNT-01
 - a. BOD: Sherwin Williams SW7007 "Ceiling Bright White".
- D. Architectural Moldings, Trims, Capitals:
 1. PNT-02
 - a. BOD: Sherwin Williams SW0050 "Classic Light Buff".
- E. Lower Level and Entry Level Walls, Partial Ceilings:
 1. PNT-03
 - a. BOD: Sherwin Williams SW0051 "Classic Ivory".
- F. Columns, Entry Level Perimeter Bookcases:
 1. PNT-04
 - a. BOD: Sherwin Williams SW0055 "Light French Grey".
- G. Entry Level Walls and Backs of Perimeter Bookcases:
 1. PNT-05
 - a. BOD: Sherwin Williams SW2821 "Downing Stone".
- H. Backs of Entry Level Perimeter Bookcases, Children's Wing Only:
 1. PNT-06
 - a. BOD: Sherwin Williams SW6678 "Sunflower".
- I. Backs of Entry Level Perimeter Bookcases, Adult/Teen Wing Only:

1. PNT-07

a. BOD: Sherwin Williams SW6860 "Eros Pink".

J. Computer Wing Walls, Backs of Entry Level Perimeter Bookcases, Computer Wing Only:

1. PNT-08

a. BOD: Sherwin Williams SW6697 "Nugget".

END OF SECTION 099123

SECTION 100610
EXTERIOR SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Philadelphia Parks and Recreation Signage Standards Manual, latest version.

1.2 REQUIRED QUALIFICATIONS SUBMITTALS

- A. The awarded Fabricator will have provided their qualifications at or prior to the time of Bid. The Fabricator is required to submit as part of the submittal process additional qualifications for any subcontractors, including but not limited to, installers, electrician, specialty sub-contractor and/or project managers not included or accepted with the bid award of the project. The Owner reserves the right to accept or reject any sub-contractor and/or project manager submitted for review. Qualifications should include: a minimum of 5-10 years relevant experience and shall provide information that illustrates the following:
 - 1. Firm/Personnel qualifications.
 - 2. Projects of similar size and complexity.
 - 3. Demonstration of high-quality craftsmanship.
 - 4. Project management team and experience.
- B. Regional Vendors:
 - 1. Urban Sign and Crane, 527 E. Chestnut Avenue, Voorhees, NJ 08360, 856.691.8388
www.urbansigncompany.com
 - 2. M.S. Signs, Inc., 6 Morris Street, Paterson, NJ 07501, 973.569.1111
www.mssign.com
 - 3. L&H Sign Company, 425 North 3rd Street, Reading, PA 19601
www.lhsigns.com
 - 4. Compass Sign Co LLC, 1505 Ford Road, Bensalem, PA 19020, 215.639.677
www.compass-sign.net
 - 5. Allied Environmental Signage, 69 Megill Road, Farmingdale, NJ 07727, 732.751.1818
www.allied-signs.com
 - 6. Or proposed qualified manufacturer, qualifications to be submitted to the Owner for approval during bid process.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Submit one (1) electronic set of shop drawings. Include plans, elevations, sections and large-scale details of sign construction, wording, and lettering layout. Show anchorages and accessory items. Provide graphic layouts of each individual sign face and message for each sign location. Show fabrication and installation details, including all sign components such as: extrusions, brackets, bracing, hardware, internal framing, etc. Alphabet of each type style required by the contract documents, including upper and lowercase, with numerals, punctuation and accents. Shop drawings MUST include all field verified conditions and dimensions. Show installation and mounting heights.
- B. Warranty: Provide documentation outlining all project warranties, including both product and manufacturing. Submit cut sheets for all specified products.
- C. Samples: Samples shall be clearly labeled on the back (where possible), designating item number, name of manufacturer, sign type and location.
 - 1. Fabricator shall submit a minimum of two (2) samples of each color and finish applied on each material type as indicated in the drawing package. Samples should represent the final finish of each element and will be used as control samples for production approval.
 - 2. Samples should represent extreme variations in color and texture that might occur during fabrication. Please submit the following samples as specified in the drawing package, list project specific submittal requirements.
 - 3. Provide color sample(s) for each specified color, process and finish. Color submittal(s) shall be submitted on each relevant substrate specified.
 - 4. Material samples of each specified Material (M1, M2 etc.) in each color and finish specified. Submit manufacturer's standard color palette where required for color and finish selection.
 - 5. CHPL samples: Custom High Pressure Laminate (CHPL) manufacturer shall supply project-specific electronic PDF proofs for content approval and minimum 8" x 10" x .060" actual material lab samples for color and finish approval from production-ready digital art work and specifications in accordance with 154 Philadelphia Parks and Recreation I SIGNAGE STANDARD MANUAL
- C. Paper templates: Templates should be fully assembled or have complete registration marks for assembly. Fabricator shall provide for Designer approval, full-size paper templates for review and approval in the field of the following sign types.
 - 1. PID.1, PLY.1, VID.1, BUL. 2C
- D. Sign mock-ups: Sign Contractor shall construct the following sign samples/mock-ups:
 - 1. PLY.1 (only required by Fabricator on initial fabrication contract for this program).

1.4 REVIEW PROCESS

- A. Each reviewing party, i.e. Designer, Owner, Architect, etc. will each require a minimum of 10 business days to review all submittals. The process and sequence of submittal and review shall be discussed and agreed to during the project kickoff meeting. Designer reserves the right to reject any submittal (shop drawing, sample, etc.) that does not satisfy the requirements as

outlined in this document including but not limited to: field conditions, construction, finish or color requirements. Submit additional drawings/ samples as required to obtain final approval.

1.5 WORK INCLUDED

- A. Site verification, fabrication, and delivery-of all sign types and quantities indicated in the final approved locations.
- B. Installation of signs may be completed by the Fabricator or the General Contractor. Fabricator to verify the sign quantities from the Copy List and Sign Location Plans and if discrepancies exist, notify the Designer of any such discrepancies.
- C. Work shall include all support structures and fasteners required for installation. Work shall include all design engineering needed to produce the project to comply with all applicable municipal, state and federal code, and structural soundness. Fabricator to provide all services, subcontractors, labor, materials and equipment needed to complete the work described in this design drawings and specifications document.
 - 1. It is the Fabricator's responsibility to have all submittal drawings signed and sealed by a Structural Engineer.
- D. Fabricator shall visit site before construction begins and inspect each proposed sign location. Any issues or concerns shall be communicated to the Designer in writing within twenty-four (24) hours. Upon award of the bid, the selected Fabricator shall arrange a meeting with the Designer to review the scope of work.
- E. Fabricator will be responsible for providing the Designer and Owner a project schedule that outlines durations for all work including delivery dates for submittals and Designer and Owner review time. Sign Contractor shall update and reissue the schedule throughout the project and communicate all changes/impacts on the schedule to Designer and Owner.
- F. Prior to installation, the Fabricator shall conduct a pre-install walk through with the Designer and Owner to address any potential issues/questions.
- G. At the substantial completion of the project the Fabricator shall perform a walk-through with the Designer and Owner to inspect the installation and create a punch list of all unsatisfactory items. Fabricator is required to complete all punch list items within 3-4 weeks of receipt of punch list.

1.6 WORK QUALITY

- A. All work to be done in a professional manner and to the highest trade standards. Fabricator is responsible for ensuring the quality standards above for all related professional and trade subcontracted work including: general carpentry, masonry, electrical, landscaping, or utilities required for the installation of all sign types as described, unless otherwise agreed to by Owner.
- B. All subcontracted work must meet the general accepted professional standards.

1.7 REFERENCE STANDARDS

- A. The following materials reference standards will apply to the work materials (use most current version of reference standards):
1. ASTM A36 Structural Steel
 2. ASTM A123 Zinc (Hot Galvanized) coatings on products fabricated from rod, pressed, and forged steel shape, plates and bars.
 3. ASTM B221 Aluminum-alloy extruded bars, rods, wire, shapes and tubes.
 4. ASTM D822 Light and Water exposure apparatus (Carbon-arc type) for testing paint, varnish, lacquer, and related products.
 5. ASTM E84 Surface-burning characteristics of building materials, lacquer and related products.
 6. AWI Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute.
 7. CDA Copper Development Association, Inc.
 8. FS L-P-391 Plastic sheet, rods and tubing, rigid, cast materials
 9. FS L-P-387 Plastic sheet, laminated, thermosetting
 10. PS-1 Construction and industrial plywood
 11. PEI Porcelain Enamel Institute
 12. TM 8135 QQ-B-613 (Fed Spec) Brass, Muntz 280
 13. UL-943 Fluorescent lamp ballasts quality
 14. ICC A117.1 – 2009 Accessible and Usable Buildings and Facilities

1.8 WARRANTIES

- A. Warrant all products (including, but not limited to: materials, hardware, and finishes) against any and all defects based on manufacturers' supplied warranties from date of installation. All manufacturer warranties should be submitted to the Designer and Owner for review.
1. Vinyl die-cut letters: warranted against delamination from substrate.
 2. Paint finishes: warranted against fading or chalking, corrosion developing beneath paint surfaces of the support systems (except for obvious vandalism or other external damage to the paint surfaces).
 3. Corrosion of the fastenings.
 4. The signs not remaining true and plumb on their supports during normal wear.
 5. Fading of the colors when matched against a sample of the original color and material.
 6. Discoloration of metal finishes.
 7. Adhesives, e.g. tape and epoxy
 8. Paneling not remaining true and plumb on their supports during normal wear.
- B. The Fabricator shall correct any and all material and/ or workmanship defects which may appear during the warranty period by restoring defective work to the standard of the contract documents at no cost to the Owner and to the Owner's satisfaction. Corrections include but are not limited to disfiguring of any surface due to chalking, rusting, bubbling, or other disintegration of the sign face or of the messages or of the edge finish of the sign inserts or panel.

- C. Manufacturer warrants that under normal wear and use the installation and signposts will not crack or fail for a period of ten (10) years from the date of substantial completion.
- D. Installer shall provide labor and material warranty for a period of one (1) full year from the date of substantial completion.

1.9 CHPL PRODUCT WARRANTIES

- A. Manufacturer warrants that under normal wear and use the workmanship and materials used in the CHPL product purchased from the Manufacturer will meet the standards set forth on the applicable specification materials and that the product will not delaminate, peel, blister, crack or fade for a period ten (10) full years from the date of purchase.
 - 1. In the event that the product does not perform as warranted:
 - 2. Manufacturer shall be allowed to conduct an on-site inspection and investigation, or be provided digital images of defects
 - 3. Manufacturer shall work directly with the end-user to resolve any warranty matter,
 - 4. The sole remedy will be the repair or replacement of the defective product at the sole discretion of the Manufacturer, and/ or
 - 5. The repair or replacement by Manufacturer shall be limited to the re-manufacture and shipment of the replacement or repaired product to the site of the end-user's product.
- B. This warranty only applies to the manufacture and material used in the manufacture of the product. Manufacturer shall not be liable for any other costs, including but not limited to installation, labor or other costs or expenses. Any repair or replacement shall be warranted for a period up to the remaining life of the original warranty. Further the repair or replacement costs incurred by Manufacturer shall not exceed the purchase price paid for the product.

1.10 QUALITY ASSURANCE

- A. Work done and materials furnished shall meet the highest industry standards in every respect and, unless otherwise specified, materials and equipment shall be new and of the latest design.
- B. The Design Intent Package should provide everything necessary for a complete contract.
- C. In the event of conflict or omission, the Fabricator shall consult the Designer for resolution. All clarifications are to be made in writing in the form of an RFI from the Fabricator to the Designer.
- D. Use only personnel thoroughly skilled and experienced with the products and method for fabrication and installation of signage specified.
- E. The Owner shall reserve the right to reject any shop drawings, samples or other submittals, as well as any finished product or installation, that cannot meet the standard of quality established. Any such decision will be considered final and not subject to recourse.

- F. Materials and hardware not specified, but necessary to the complete functioning of the sign, shall conform to the quality level established.
- G. Substitutions of items specifically indicated in this specifications package that serve the same function with equal performance will be considered upon submission of substitution. SEE DIV 1.

PART 2 - MATERIALS AND PRODUCTS

2.1 ALUMINIUM

- A. Aluminum shall be of best commercial quality and the various forms shall be straight and true. There shall be no scratches, scars or buckles. Size thickness and finish of aluminum shall be per NAAMM "Metal Finishes Manual". Comply with the following industry standards.
- B. Aluminum sheets shall conform to ASTM B209 6061-T6
- C. Aluminum extrusions shall conform to ASTM B241 6063 T6. Wall thickness shall be a minimum of 1/8" thick unless otherwise shown.
- D. Brushed Finishes-Brush with abrasive of increasing grit# in a linear directional pattern.
- E. Final surface shall have visible grain pattern to match sample approved by Designer. Spray with clear protective finish.
- F. Polished Finish-Brush with abrasive of increasing grit #. Buff to a mirror finish with no visible grain. Match sample approved by Designer. Spray with clear protective finish.
- G. Non-Directional Finish-Brush with abrasive mounted in a random orbital sander. Match sample approved by Designer. Spray with clear protective finish.

2.2 STAINLESS STEEL

- A. Structural Stainless steel shapes to be rolled or laser fused, as manufactured by Stainless Structurals, LLC. (936-538- 7600, www.stainless-structurals.com)
- B. Chromium stainless steel sheet. Use type 304 or type 316 stainless steel with 16% chromium and 10% nickel.
- C. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness. Stainless Steel Plate, Sheet and Strip: Provide stainless steel plate, sheet, or strip, AISI Type 302, complying with requirements of ASTM A 167.
- D. Stainless Steel Finishes: Finish designations prefixed by "AISI" conform to the system established by the American Iron and Steel Institute for designating finishes.

- E. Finish: Bead blasted & Pickled.

2.3 CUSTOM HIGH PRESSURE LAMINATE

- A. Provide Custom High pressure laminate as manufacturer by iZone or an approved equal.
- B. Custom High Pressure Laminate material composed of required layers of phenolic resin impregnated brown kraft filler paper to produce specified thicknesses, surfaced by a layers of melamine overlay, graphics imaged on saturation grade paper with UV resistant pigment based process color inks, and with an optically clear UV overlay that will resist no less that 99% of all sunlight and UV rays, as well as provide a graffiti resistant surface that allows for removal with standard cleaners.
- C. Layers of material are to be assembled, and heat/ pressure consolidated at approximately 1200 PSI at temperatures exceeding 275° Fahrenheit at manufacturer's prescribed time frames.
- D. All manufacturing processes of printing, pressing, machining, finishing and crating to be accomplished within a single standalone manufacturing facility to ensure consistent quality control and providing standard product delivery times of three weeks.

2.4 WOOD

- A. #1 grade douglas-fir vertical grain lumber, minimal to no knots. Sustainably harvested. Eased edges. Apply two coats of Seal-One Nano Penetrating clear wood sealer.

2.5 REFLECTIVE GRAPHICS

- A. Provide 3M Scotchlite enclosed lens reflective sheeting or approved equal.

2.6 CONCRETE

- A. All concrete footers are to be poured in place.
- B. All concrete footers are to be poured from thoroughly mixed and agitated concrete in order prevent unreasonable voids in the finished casting.
- C. Concrete to meet specified "PSI Test" for strength: 3,500 psi minimum. Concrete to meet specified "Slump test" before pouring footing. All footings to extend past the frost line.
- D. Any footers or posts for signs will be placed in wet concrete and allowed to fully cure in place before any signage is attached or mounted to it in any way. All exposed faces of concrete shall receive a finish to match existing, adjacent surfaces.

2.7 VHB FOAM TAPES

- A. Provide 3M Scotch VHB 4930.
- B. Adhesive shall be Acrylic VHB.
- C. Carrier shall be closed cell foam.

2.8 ACCESSORIES ANCHORS AND FASTENINGS

- A. Provide anchors and fasteners required to secure work in place. Do not expose fastenings on surface of sign panels unless specifically noted otherwise. Do not deform, distort or discolor sign face surfaces by attachment of concealed fastenings.
- B. All fastenings shall be non-corrosive and resistant to oxidation or other corrosive action, of the same composition completely through their cross sections, particularly when used below grade. Use highest quality stainless steel hardware and fasteners.
- C. Anchors, inserts or fasteners shall be compatible with sign materials, shall not result in galvanic action or chemical interaction of adhesives and shall have demonstrable and sufficient strength for intended use.
- D. Steel anchors and fastenings for exterior use shall be galvanized in accordance with ASTM A153.
- E. Fabricate and install signs with fastenings to withstand all actions imposed by use; 30 psf wind perpendicular to surfaces, water, ice, snow loads and similar forces.
- F. Anchor bolts in concrete shall be cast in place. Fabricator shall furnish instructions for the setting of anchors and bearing plates. Fabricator shall ascertain that the items are properly set during the process of the work.
- G. Secure work with fastenings of same color and finish as the components they secure where they are exposed to view, unless noted otherwise. All exposed fasteners must be vandal resistant and have vandal-proof "spanner" type slots to be removed only with a special driver head.

PART 3 - EXECUTION

1.11 PROTECTION AND STORAGE

- A. Fabricator is responsible for storage of signs and assemblies and protection from damage at the shop, in transit and until erected in place, complete, inspected and accepted by Owner.
- B. Fabricator is responsible for the replacement pilferage both prior to and until inspection and acceptance of installation by the Owner.

1.12 INSPECTION

- A. All production materials, color samples and paints, fabricated or partially fabricated items shall be available for inspection, on-site or in the shop, by the Owner or Designer during the manufacturing process and until final delivery, installation and acceptance, to determine compliance with the requirements of these specifications. Shop inspection approvals do not guarantee final acceptance of installed work.

1.13 INSTALLATION

- A. Install sign units and components with concealed fasteners unless otherwise shown. Refer to drawings for general method of installation. Verify each surface in field to determine appropriate mounting hardware. Fabricator is responsible for determining where below ground or in-wall structural tie-ins may be required. All elements should be installed true and plumb in accordance with the design intent of this document.

Fabricator is responsible for determining the location of underground structures and utilities on ground-mounted signs. Any conflicts should be brought to the attention of the Owner and Designer.

- B. Sign location drawings show approximate locations of signs. Fabricator, Designer and Owner shall conduct a pre-install mark out walk through to confirm all locations and identify areas of conflict.

1.14 REGULATORY REQUIREMENTS

- A. All installation work shall comply with applicable municipal, state and federal codes, sign ordinances and ADA guidelines for handicapped and fire/life safety signing.
- B. All OSHA safety requirements will be implemented during fabrication and installation as needed or required to comply with safety regulations.
- C. All field/site work shall be conducted in compliance with the Owner/Construction Manager's requirements/ regulations for the site, particularly areas open and accessible to the public. Work area protection shall be required as needed and all site-specific rules should be reviewed and outlined during the project kick-off meeting.

1.15 CLEAN UP

- A. Daily and upon completion of installation remove all waste, dirt, wrappings and excess materials, tools and equipment, and thoroughly clean all surfaces to the satisfaction of the Owner.

1.16 REORDERING

- A. Reordering all items specified in this package shall be available to the Owner in additional quantities for a period of 10 years after completion of all work called for in this specification.

END OF SECTION 100610

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. Sustainable Design Submittals:

C. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

E. 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 of each type of dimensional character.
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.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including

taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.

2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Sustainability and LEED Standards:
 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 4. Forest Stewardship Council (FSC)

5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Brass Castings: ASTM B584, lead-free alloy recommended by manufacturer and finisher for finish indicated.
- E. Brass Sheet (Yellow Brass): ASTM B36/B36M, lead-free alloy recommended by manufacturer and finisher for finish indicated.
- F. 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.

2.2 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.
 - 2. 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.

2.3 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.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- 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.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 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.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 101423.16

ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least half size .
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample .
 - 2. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.

3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

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

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products .

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and MA 521 CMR .

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
 - a. Face Panel: 3/16 inch thick acrylic. Corners, color, text as indicated on Drawings.
 - b. Intermediate Panel: 1/16 inch thick acrylic. Corners and color as indicated on Drawings.
 - c. Backer Panel: 1/8 inch thick acrylic. Corners and color as indicated on Drawings.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following :
 - a. **APCO Graphics, Inc**
 - b. **Best Sign Systems, Inc.**
 - c. **Mohawk Sign Systems**

d. Vista System, LLC

3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: As indicated on Drawings .
 - b. Corner Condition in Elevation: As indicated on Drawings .
4. Mounting: Surface mounted to wall with two-face tape as indicated on Drawings.
5. Text and Typeface: As indicated on Drawings . Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.
- B. Aluminum Mounting Brackets: Brushed aluminum brackets with mechanical fasteners of the same material.
- C. Exterior Mounting: Threaded studs with sleeve spacer, integral to back of sign material.

2.5 FABRICATION

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

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 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls and surfaces as indicated on Drawings and according to the accessibility standard .
- C. Mounting Methods:
 - 1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
 - 2. Aluminum Mounting Brackets: Using a template, drill holes in surface aligning with pilot holes on bracket. Remove loose debris from hole and substrate surface.
 - 3. Exterior Mounting: Using a template, drill holes in surface aligning with studs on back of sign. Install wall anchors appropriate for the surface and substrate. Remove loose debris from hole and substrate surface.

3.2 ADJUSTING AND CLEANING

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

END OF SECTION 101423.16

SECTION 102800
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public and Staff-use restroom accessories for all restrooms.
 - 2. Custodial accessories for Custodial 009.

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 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.

1.4 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including

taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.

2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.5 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

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TOILET, BATH, AND LAUNDRY ACCESSORIES
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1.7 CLOSEOUT SUBMITTALS

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

1.8 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: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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 concentrated load applied in any direction and at any point.
 - 2. Shower Seats: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM AND SHOWER ROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single manufacturer and from a single product line unless otherwise indicated.
- B. Manufacturers:
 - 1. Bobrick Washroom Equipment, Inc., Clifton Park, New York.
 - 2. American Specialties, Inc. (ASI), Yonkers, New York.
- C. Provide (1) type of each accessory per restroom, unless otherwise indicated.

- D. Where both recessed and surface-mounted accessories are specified, install recessed accessories in new partitions only.
- E. All accessories to be locked with a single key of either type CAT74 (Bobrick) or type E114 (ASI). Soap dispenser may be locked/opened with special key provided by the manufacturer.
- F. Basis-of-Design Products: Subject to compliance with requirements, provide the following toilet room accessories:

1. Toilet Tissue (Roll) Dispenser:

- a. **Bobrick B-4388**, Recessed Toilet Tissue Dispenser, Satin Finish, Two Rolls.
- b. **Bobrick B-4288**, Surface-Mounted Toilet Tissue Dispenser, Satin Finish, Two Rolls.

2. Towel Dispenser and Waste Receptacle:

- a. **Bobrick B-43944**, Recessed Paper Towel Dispenser and Waste Receptacle, Satin Finish, 15-Gallon Waste
- b. **Bobrick B-43949**, Surface-Mounted Paper Towel Dispenser and Waste Receptacle, Satin Finish, 15-Gallon Waste

3. Electric Hand Dryers:

- a. **XLERATOReco**, XL-BW-ECO 1.1N High Speed Commercial Hand Dryer, Excel Dryer, White Thermoset Cover, Automatic Sensor, Surface Mount, Noise Reduction Nozzle, No Heat, 4.5 Amps 110/120V

4. Grab Bars:

a. Bobrick B-5806 series.

- 1) Omit from Restroom 002.

- b. Mounting: Flanges with concealed fasteners.
- c. Material: Stainless steel, 0.05 inch thick.

- 1) Finish: Smooth, No. 4 finish (satin) on eds and slip-resistant texture in grip area.

- d. Outside Diameter: 1-1/4 inches.
- e. Quantity, Configuration and Length: Furnish in quantities and dimensions as indicated on Drawings and as required for ADA compliant installation, including at water closets and shower stall.

5. Mirror:

- a. **Bobrick B-290**, Welded Frame Mirror, Satin Finish.

6. Sanitary-Napkin Disposal Unit:

- a. **Bobrick B-4353**, Recessed Sanitary Napkin Disposal, Satin Finish, 1.2-Gallon.
- b. **Bobrick B-270**, Surface-Mounted Sanitary Napkin Disposal, Satin Finish, 1-

Gallon.

7. Sanitary Napkin Dispenser:

- a. **Bobrick B-4706C**, Recessed Napkin-Tampon Dispenser, Free Operation, Satin Finish
- b. **Bobrick B-4706C**, Recessed Napkin-Tampon Dispenser, Free Operation, Satin Finish

8. Liquid-Soap Dispenser:

- a. **Bobrick 818615**, Surface-Mounted Heavy Duty Manual Liquid Soap Dispenser, 40 fl. oz.

9. Baby-Changing Station:

- a. **Koala Kare KB310-SSWM** Horizontal Stainless Steel Surface-Mounted baby changing station.

10. Sharps Disposal:

- a. **Bobrick B-35016**, Recessed Sharps Disposal Cabinet
- b. **Bobrick B-350169**, Surface-Mounted Sharps Disposal Cabinet.

2.3 CUSTODIAL ACCESSORIES

- A. Provide (1) type of each accessory in Janitor Closet.
- B. Basis-of-Design Products: Subject to compliance with requirements, provide the following custodial accessories:

1. Utility Shelf:

- a. **Bobrick B-239 x 34** Surface-Mounted Utility Shelf / Mop Holders / Coat Hooks, Satin Finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF TOILET, BATH, AND LAUNDRY ACCESSORIES

- 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 113100

APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Refrigeration appliances.
 - 2. Cooking appliances.
 - 3. Counter-top appliances.
 - 4. Laundry appliances.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.

4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPLIANCES, GENERAL

- A. Contractor to furnish and install all appliances as listed in this Specification and as indicated on Drawings. Provide in quantities and locations as indicated on Drawings.
- B. Appliance basis-of-design products to be confirmed in Submittal review. Contractor to provide most current version of basis-of-design product as currently available by manufacturer at date of

purchase at no additional cost to Project. Appliances no longer manufactured at time of purchase are to be substituted with equal or greater appliance at no additional cost to Project.

- C. Appliances are to be ADA compliant and Energy Star certified unless otherwise indicated.

2.2 REFRIGERATOR/FREEZERS

- A. Basis of Design Product: Subject to compliance with requirements, provide the following product:
 - 1. Manufacturer: Bosch.
 - 2. **Product: 800 Series 36 Inch Wide 20.8 Cu. Ft. Energy Star Certified French Door Refrigerator with MultiAirFlow and VitaFreshPro.**
 - 3. Product Number: B36CT80SNS.
 - 4. Type: Freestanding, counter-depth 3-door refrigerator.
 - 5. General Features:
 - a. Interior light in refrigeration compartment.
 - b. Frost-free.
 - 6. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
 - 7. Front Panel(s): Stainless steel.

2.3 DISHWASHERS

- A. Basis of Design Product: Subject to compliance with requirements, provide the following product:
 - 1. Manufacturer: Bosch.
 - 2. **Product: 800 Series 24 Inch Wide 15 Place Setting Built-In Top Control Dishwasher with CrystalDry and PrecisionWash.**
 - 3. Product Number: SGX78C55UC.
 - 4. Color: Stainless Steel.
 - 5. ADA height compliant.
 - 6. Stainless steel interior.

2.4 RANGE

- A. Basis of Design Product: Subject to compliance with requirements, provide the following product:
 - 1. Manufacturer: Bosch.

2. Product: 30" Slide-In Electric Range.

3. Product Number: 800 Series HEI8056U.
4. Color: Stainless Steel.
5. 34" ADA counter height compliant.
6. Electric.

2.5 RANGE HOOD / MICROWAVE OVEN

- A. Basis of Design Product: Subject to compliance with requirements, provide the following product:

1. Manufacturer: Bosch.
- 2. Product: 30" Over-The-Range Microwave.**
3. Product Number: 800 Series HMT8045U.
4. Color: Stainless Steel.
5. Exhaust to outside.

2.6 LAUNDRY WASHER AND DRYER

- A. Basis of Design Product: Subject to compliance with requirements, provide the following product:

1. Manufacturer: Bosch.
- 2. Product: Compact Washer and Heat Pump Dryer.**
3. Product Number: 800 Series - WGB246AXUC - WQB245AXUC.
4. Color: Stainless Steel.
5. Energy star certified, electric.
6. Provide washer and dryer from same manufacturer and product line.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- B. Appliances to be installed plumb and level following all manufacturer installation instructions and requirements.

3.2 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.
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 113100

SECTION 116800

PLAY EQUIPMENT

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 freestanding and composite structure playground equipment.
- B. Related Sections:
 - 1. Section 321816 "Playground Protective Surfacing" for protective surfacing under and around playground equipment.

1.3 DEFINITIONS

- A. Fall Height: According to ASTM F 1487, "the vertical distance between a designated play surface and the protective surfacing beneath it."
- B. Critical Height: Standard measure of shock attenuation. According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."
- C. HDPE: High-density polyethylene.
- D. IPEMA: International Play Equipment Manufacturers Association.
- E. LLDPE: Linear low-density polyethylene.
- F. MDPE: Medium-density polyethylene.
- G. Use Zone: According to ASTM F 1487, the "area beneath and immediately adjacent to a play structure or equipment that is designated for unrestricted circulation around the equipment and on whose surface it is predicted that a user would land when falling from or exiting the equipment."

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Extent of surface systems and use zones for equipment.
 - 2. Critical heights for playground surfaces and fall heights for equipment.
 - 3. Include drawings showing colors selected for final approval.
- B. Qualification Data: For qualified Installer manufacturer, and testing agency.
- C. Product Certificates: For each type of playground equipment, from manufacturer.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Provide inspection report from CPSI (Certified Playground Safety Inspector) as outlined in 3.4.
- B. Maintenance Data: For playground equipment and finishes to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm whose playground equipment components have been certified by IPEMA's third-party product certification service.
- B. Installer Qualifications: An employer of workers approved by manufacturer.
- C. Safety Standards: Provide playground equipment complying with or exceeding requirements in ASTM F 1487 and CPSC No. 325.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLAY EQUIPMENT

- A. Play Equipment: Subject to compliance with requirements, provide products by BCI Burke Company 727 Northwest Way, Fond du Lac, WI 54937, or approved equal. Local contact: Recreation Resource Kevin Umbreit kevinu@recreation-resource.com
 - 1. Nucleus NU-3200. Color: Platform – Blue. Post - Blue. Railings/Punch Roof – Ocean. Accessories-Fuchsia. HDPE Panels – Purple, Ocean and Blue. 2 Color HDPE – Purple/Gray. Slides, stainless steel.
 - 2. Level X Launch. Color: Arched Posts Lilac, Straight Post Fuchisa. HDPE Panels, Ocean and Blue. 2 Color HDPE Purple/Gray. Slide, stainless steel.
 - 3. Swift Twist. Color: Post Fuchsia, HDPE Blue.
 - 4. StemPlay BB-3293. Color: Arched Posts Lilac, Straight Post Fuchisa. HDPE Panels, Ocean and Blue.
 - 5. 5-Seat Swing – 2 belt, 2 toddler, 1 ADA. 5" OD Arch Swing with Anti-Wrap. Post Color, Ocean. Crossbar, Lilac.
 - 6. Orb Rocker: Color: Frame, Ocean. Seat: Blue.

2.2 CAST-IN-PLACE CONCRETE

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" to produce normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3500 psi (20.7 MPa), 3-inch (75-mm) slump, and 1-inch- (25-mm-) maximum-size aggregate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, site surface and subgrade drainage, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading required for placing protective surfacing is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Verify locations of playground perimeter and pathways. Verify that playground layout and equipment locations comply with requirements for each type and component of equipment.

3.3 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Anchor playground equipment securely, positioned at locations and elevations indicated.
 - 1. Maximum Equipment Height: Coordinate installed heights of equipment and components with finished elevations of protective surfacing. Set equipment so fall heights and elevation requirements for age group use and accessibility are within required limits. Verify that playground equipment elevations comply with requirements for each type and component of equipment.
- B. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.
- C. Post Set on Subgrade: Level bearing surfaces with drainage fill to required elevation.
- D. Post Set with Concrete Footing: Comply with ACI 301, ACI 301M for measuring, batching, mixing, transporting, forming, and placing concrete.
 - 1. Set equipment posts in concrete footing. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing.
 - a. Place concrete around posts and vibrate or tamp for consolidation. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
 - 2. Embedded Items: Use setting drawings and manufacturer's written instructions to ensure correct installation of anchorages for equipment.
 - 3. Concrete Footings: Smooth top, and shape to shed water.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a CPSI qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. Engage a representative (it may be factory-authorized service) to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections: For playground and playground equipment and components during installation and at final completion and to certify compliance with ASTM F 1487, CPSC No. 325.
- D. Prepare test and inspection reports to be submitted prior to Substantial Completion.

END OF SECTION 116800

SECTION 122413
ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually and motor operated single-roller shades.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 260010 "Supplemental Requirements for Electrical" for additional requirements applicable to coordinating, scheduling, and sequencing of the electrical Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - b. Include rated capacities, operating characteristics, electrical characteristics, features, and furnished accessories.

B. Shop Drawings:

1. Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
2. Motor-Operated Shades: Include diagrams for power, signal, and control wiring.

C. Samples for Verification: Actual sample of finished products for each type of roller shade including actual shadeband material and installation accessories.

1. Size: Manufacturers' standard size .

D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

E. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating percentage of postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For product, indicating compliance with requirements for low-emitting materials.

1.3 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of shadeband material.
- B. Qualification Statements: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Sustainability and LEED Standards:
 - 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
 - 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
 - 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
 - 4. Forest Stewardship Council (FSC)
 - 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
 - 6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
 - 7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.7 MOCKUPS

- A. Install one of each type of roller window shade as a mockup to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 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.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Defects in materials and workmanship beyond normal wear and tear.
- b. Faulty operation of operating system components.
- c. Deterioration of fabric beyond normal use.

2. Warranty Period:

- a. Roller Window Shades: Five year(s) from date of Substantial Completion.
- b. Motorized Components: Five year(s) from date of Substantial Completion.
- c. Fabric: 10 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain roller shades from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Window Covering Safety Standard: Provide roller window shades that comply with WCMA A100.1 .
- B. Fire Performance: Tested in accordance with and meeting the flame propagation performance criteria of Test 1 or Test 2, as appropriate, of NFPA 701; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
1. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
- a. Drapery Operators: UL CCN FDDR, including UL 325.
- D. Accessibility Standards: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" for roller window shades designated as accessible.
- E. Laboratory Test Reports: For product, indicating compliance with requirements for low-emitting materials.

2.3 ROLLER WINDOW SHADES

- A. Manually and Motor Operated, Single-Roller Shades: For interior use in rectangular openings.
1. Basis-of-Design Product: Subject to compliance with requirements, provide **Draper Inc** or comparable product by one of the following:
 - a. MechoShade
 - b. Lutron Electronics Co., Inc
 2. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - a. Direction of Shadeband Roll: Regular, from back (exterior face) of roller .
 - b. Shadeband-to-Roller Attachment: Manufacturer's standard method .
 3. Provide manufacturer's standard motor operation and controls at units as indicated on Drawings.
 4. Shadebands:
 - a. Shadeband Material: Light-filtering fabric .
 - b. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - 1) Type: Elliptical slat enclosed in sealed pocket of shadeband material .
 - 2) Color and Finish: As selected by Architect from manufacturer's full range; BOD selection Phifer, SheerWeave Infinity2 (5% Open), "Wheat" to be reviewed and confirmed in Submittal review.
 5. Mounting Hardware: Brackets or endcaps, with endcap covers where exposed, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and installation location and conditions indicated.
 6. Installation Accessories:
 - a. Front Fascia: Aluminum extrusion that conceals front and underside of roller and shadeband assembly and attaches to roller endcaps without exposed fasteners.
 - 1) Shape: L-shaped .
 - 2) Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches .
 - b. Exposed Headbox: Extruded-aluminum enclosure including front fascia, L-shaped top/back cover, and removable bottom closure, that fully conceals roller and shadeband assembly, and attaches to roller endcaps without exposed fasteners.
 - 1) Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 3 inches .
 - c. Installation Accessories Color and Finish: As selected from manufacturer's full range ; BOD selection "White" to be reviewed and confirmed in Submittal review .

2.4 MANUAL OPERATION

A. Manual Corded Operation:

1. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - a. Bead Chains: Manufacturer's standard bead chain with WCMA A100.1 compliant tension device installed on roller window shade by manufacturer and mounted on sill .
 - 1) Loop Length: Full length of roller shade .
 - 2) Limit Stops: Provide upper and lower ball stops.
 - b. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - 1) Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

2.5 MOTORIZED OPERATION

- ### A. Motorized Operating Systems: Factory-assembled, motorized roller window shades with shade-operator system of size and capacity and with features, characteristics, and accessories required for conditions indicated, complete with motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for complete operation. For wired controls, include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Type:

1. Radio Frequency (RF) Motor with Wireless Controls: Roller window shade manufacturer's standard tubular radio frequency motor to suit conditions indicated, enclosed in roller, communicating to control devices through wireless RF signal.
 - a. Motor Electrical Characteristics: 120-V ac .
 - b. Motor Functions:
 - 1) Quiet Operation Motor: Manufacturer's standard .
 - c. Controls:
 - 1) RF Wireless Wall Switch Transmitters:
 - a) Single Channel Surface-Mount Wall Switch: With open, close, and stop command buttons, and one channel button for operation of one motorized shade or one group of motorized shades.
 - b) Color: As selected by Architect from manufacturer's full range .

- ### C. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.

- D. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
- E. Maximum Total Shade Width: As required to operate roller shades indicated .
- F. Maximum Shade Drop: As required to operate roller shades indicated .
- G. Maximum Weight Capacity: As required to operate roller shades indicated .

2.6 SHADEBAND MATERIALS

- A. Light-Filtering Fabric: PVC free woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer .
 - 2. Type: 100% Glass Yarn, Acrylic coated + White Flock .
 - 3. Weave: Basketweave .
 - 4. Thickness: 0.019 in .
 - 5. Weight: 14.75 oz / cu. yd.
 - 6. Openness Factor: 3 percent.
 - 7. Color: As selected by Architect from manufacturer's full range .

2.7 FABRICATION OF ROLLER WINDOW SHADES

- A. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows:
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- B. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ROLLER WINDOW SHADES

- A. Install roller shades level, plumb, aligned and centered on openings, and aligned with adjacent units in accordance with manufacturer's written instructions.
 - 1. Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: As indicated on Drawings .
- C. Electrical:
 - 1. Connect motor-operated roller window shades to building electrical system.
 - 2. Comply with manufacturer's written installation instructions.

3.3 ADJUSTING

- A. Adjust and balance roller window shades to operate smoothly, easily, safely, and free from binding or malfunction through full operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller window shade surfaces, after installation, in accordance with manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller window shades are without damage or deterioration at time of Substantial Completion.
- C. Protect electrical wiring, cabling, raceways, and boxes, after installation. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use, before time of substantial completion.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller window shades.

END OF SECTION 122413

SECTION 124813

ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roll-up rail mats.
2. Surface-mounted frames.
3. Resilient entrance mats.

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 for floor mats and frames and resilient entrance mats.

B. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor frames .

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and

product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
 - c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
3. Sustainable Agriculture Network's Sustainable Agriculture Standard
4. Forest Stewardship Council (FSC)
5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 201

1.5 CLOSEOUT SUBMITTALS

- ##### A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

- ##### A. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" .

2.2 ROLL-UP RAIL MATS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Construction Specialties, Inc.; Pedimat M2**.
- B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 2 inches wide by 7/16 inch thick, sitting on continuous vinyl cushions.
 - 1. Tread Inserts: Manufacturer's standard "Monotuft" HD carpet insert.
 - 2. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors; BOD selection "7325 Wrought Iron" to be reviewed and confirmed in Submittal review.
 - 3. Rail Color: Manufacturer's standard clear anodized.
 - 4. Hinges: Aluminum .
 - 5. Mat Size: As indicated .

2.3 FRAMES

- A. Surface-Mounted Frames:
 - 1. Frames: Manufacturer's standard aluminum frame, attached to mat at all four edges, with welded mitered corners.
 - a. Aluminum Color: Manufacturer's standard clear anodized.

2.4 RESILIENT ENTRANCE MATS

- A. Carpet-Type Mats: Polypropylene carpet bonded to 1/8- to 1/4-inch thick, flexible vinyl backing to form mats 3/8 or 7/16 inch thick with nonraveling edges.
 - 1. Colors, Textures, and Patterns: As selected by Architect from full range of manufacturer colors
 - 2. Mat Size: 4'-6" x 3'-0"
- B. Manufacturer: American Floor Mats; 152 Rollins Avenue #102, Rockville, MD 20852; 800-762-9010 / 301-881-7840 (fax); www.americanfloormats.com
 - 1. Basis of Design: Super Berber Matting

2.5 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.

- C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.
 - 1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 129300

SITE FURNISHINGS

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. Backed Bench
 - 2. Backed Bench (Add Alternate 1)
 - 3. Backless Bench
 - 4. Trash Receptacle
 - 5. Trash Receptacle (Add Alternate 2)
 - 6. Recycling Receptacle
 - 7. Bike Rack
 - 8. Pedestal Table
 - 9. Game table
 - 10. Removable Bollard
 - 11. Shade Structure (Add Alternate 5)
- B. Related Requirements:
 - 1. Section 321613 "Cast-in-Place Concrete" for installing equipment and/or anchor bolts cast in concrete footings.
 - 2. Section 312000 "Earth Moving" for excavation for installing concrete footings.
 - 3. Section 321226 "Asphalt Paving" for surfacing under and around equipment.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Anchors, Fasteners, Fittings, and Hardware: Provide Stainless steel; commercial quality, tamperproof, vandal and theft resistant unless indicated otherwise on the Drawings.

- B. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.
- C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.2 BENCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor, Inc., P.O. Box 142, Mifflintown, PA 17059, 717-436-2106 or 800-598-4018, www.dumor.com, or approved comparable product.
 - 1. Backless Bench
 - a. Model: 164-60
 - b. Finish / Color: Powdercoat / Black.
 - c. Length: 6'
 - d. Center arm and 'Fairmount Park' security panel.
 - e. Mount: As shown on Drawings.
 - 2. Backed Bench (Base Bid & Add Alternate 1)
 - a. Model: 160-60
 - b. Finish / Color: Powdercoat / Black.
 - c. Length: 6'
 - d. Center arm and 'Fairmount Park' security panel.
 - e. Mount: As shown on Drawings.

2.3 TRASH RECEPTACLE (BASE BID & ADD ALTERNATE 2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor, PO Box 142, Mifflintown, PA 17059, 1-800-598-4018, or approved comparable product.
 - 1. Model: 157-32-FTO
 - 2. Finish / Color: Powdercoat / Black.
 - 3. Mount: As shown on Drawings.

2.4 RECYCLING RECEPTACLE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor, PO Box 142, Mifflintown, PA 17059, 1-800-598-4018, or approved comparable product.
 - 1. Model: 157-32-FTO
 - a. Top With recycling logo
 - 2. Finish / Color: Powdercoat / Recycle Blue.
 - 3. Mount: As shown on Drawings.

2.5 BIKE RACK

- A. Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Dumor, PO Box 142, Mifflintown, PA 17059, 1-800-598-4018, or approved comparable product.
1. Model: 83
 2. Finish / Color: Powdercoat / Black.
 3. Mount: As shown on Drawings.

2.6 PEDESTAL TABLE

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide furnishings manufactured by Dumor, Inc., P.O. Box 142, Mifflintown, PA 17059, 717-436-2106 or 800-598-4018, www.dumor.com, or approved comparable product.
1. Model: 76-34PL and 76-33PL
 2. Material: Steel and Recycled Plastic
 3. Mount: As shown on drawings
 4. Steel Finish/Color: Powdercoat/Black
 5. Recycled Plastic Color: TBD, to be selected from manufacturer standard colors.

2.7 GAME TABLE

- A. Basis-of-design Manufacture: Subject to compliance with requirements, provide furnishings manufactured by Dumor, Inc., P.O. Box 142, Mifflintown, PA 17059, 717-436-2106 or 800-598-4018, www.dumor.com, or approved comparable product.
1. Model: 78-32PL-S-2
 2. Material: Steel and recycled plastic
 3. Mount: As shown on drawings
 4. Steel Finish/Color: Powdercoat/Black
 5. Recycled Plastic: TBD

2.7 BOLLARD

- A. Basis-of-design Manufacture: Subject to compliance with requirements, provide furnishings manufactured by Dumor, Inc., P.O. Box 142, Mifflintown, PA 17059, 717-436-2106 or 800-598-4018, www.dumor.com, or approved comparable product.
1. Model: 400-42/S-1SL
 2. Finish / Color: Powdercoat / Black.

2.7 SHADE STRUCTURE (ADD ALTERNATE 5)

- A. Shade Basis-of-Design Product: Subject to compliance with requirements, provide furnishings manufactured by Poligon, 4240 136th Avenue, Holland, MI 49424, 616-888-3500, or approved comparable product.
1. Model: Millennium Trellis MIL-9x28
 2. Roof Type: 3 x 3 Steel Latilla
 3. Material: Steel
 4. Mount: As shown on the drawings

- 5. Steel Finish/Color: TBD
- 6. Size: 9' x 28'

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, 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 installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and **securely anchored** at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Install flagpole in concrete footing as per manufacturer recommendations with lightening ground spike.

3.3 CLEANING

- A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 129300

SECTION 142000

LU/LA PASSENGER ELEVATORS - CABLE HYDRAULIC AND IN-LINE GEARED

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Passenger Elevators:
 - 1. Drive: In-line geared traction machine room-less drive.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete. Concrete for elevator machine foundation, and pit and required sleeves for service penetrations.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 05 50 00 - Metal Fabrications: Miscellaneous supports, lintels, etc.
- D. Section 08 31 16 - Access Doors and Panels: Fire rated access doors into hoistway.
- E. Section 09 21 16 - Gypsum Board Assemblies: Gypsum shaft walls.
- F. Section 09 65 00 - Resilient Flooring: Floor finish in cab.
- G. Section 28 35 00 - Detection and Alarm: Fire and smoke detectors and interconnecting devices.
- H. Division 26 - Electrical:
 - 1. Electrical characteristics and wiring connections.
 - 2. Electrical service to lockable fused disconnect in elevator machine room.
 - 3. Electrical service for machine room, machine room convenience outlets, machine room lighting and lighting in elevator pit.
 - 4. Telephone service and wiring connections.

1.3 REFERENCES

- A. American Disabilities Act (ADA):
 - 1. ADAAG - Americans with Disabilities Act, Architectural Guidelines.
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME A17.1 /CSA B-44 - Section 5.2 Safety Code for Elevators and Escalators, Limited-Use/Limited Application Elevators.
 - 2. ASME A17.5 - Elevator and Escalator Electrical Equipment.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electric Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 30.
- B. Product Data: Manufacturer's data sheets on elevators, including:
 - 1. Manufacturer's installation instructions, including preparation, storage and handling requirements.
 - 2. Include complete description of performance and operating characteristics.
 - 3. Show maximum and average power demands.
 - 4. Storage and handling requirements and recommendations.
- C. Shop Drawings:
 - 1. Show typical details of assembly, erection, and anchorage.
 - 2. Include wiring diagrams for power, control, and signal systems.
 - 3. Show complete layout and location of equipment, including required clearances and coordination with hoistway.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- F. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and adjustment of cable tension and periodic cleaning and maintenance of all railing and infill components.

1.5 LEED SUBMITTALS

- A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")
 - 1. Product Material Cost: Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site.
 - 2. Product Data for Credit - Environmental Product Declarations (EPD): For all products that meet EPD requirements, EPDs with relevant sections highlighted.
 - 3. Product Data for Credit - Sourcing of Raw Materials: For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location. Highlight relevant information.
 - a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
 - b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.

- c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
 - d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.
- 4. Product Data for Credit - Material Ingredients: For all products that meet Material Ingredient Reporting and/or Material Ingredient Optimization requirements, documentation of chemical inventory from manufacturer, health product declaration (HPD), or verification of criteria compliance from approved third party program, or documentation of criteria compliance from the manufacturer or verification of criteria compliance from approved third-party program. Highlight relevant information.
- 5. Product Data for Credit Low-Emitting Materials: For all products, data sheets, MSDS, third-party certifications, or testing reports demonstrating compliance with relevant testing standards and VOC content limits.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm with minimum 10 years' experience in manufacturing of elevators, with evidence of experience with similar installations of type specified.
- B. Installer Qualifications: Licensed to install equipment of this scope, with evidence of experience with specified equipment. Installer shall maintain an adequate stock of replacement parts, have qualified people available to ensure fulfillment of maintenance and callback service without unreasonable loss of time in reaching project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store components off the ground in a dry covered area, protected from adverse weather conditions.

1.8 PROJECT CONDITIONS

- A. Do not use elevator for hoisting materials or personnel during construction period.

1.9 WARRANTY

- A. Standard Warranty: A two-year limited warranty covering replacement of defective parts and excluding labor. Preventive maintenance agreement required.
- B. Extended Warranty: An additional five year limited warranty covering replacement of defective parts and excluding labor for a total of seven years.
 - 1. Preventive maintenance agreement required.

1.10 MAINTENANCE SERVICE

- A. Service and maintenance for elevator system and components for the following period from Date of Substantial Completion.
 - 1. Maintenance Period: Two years.
- B. Include systematic examination, adjustment, and lubrication of elevator equipment. Repair or replace parts whenever required. Use parts produced by manufacturer of original equipment. Replace wire ropes when necessary to maintain required factor of safety.
- C. Provide emergency call back service for this maintenance period.
- D. Perform maintenance work using competent and qualified personnel approved by elevator manufacturer or original installer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Garaventa Lift; United States – Email: richard.henderson@garaventalift.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Passenger Elevators are to be in Compliance with the Following:
 - 1. ASME A17.1 - Safety Code for Elevators and Escalators, Limited-Use/Limited Application Elevators.
 - 2. ASME A17.5 - Elevator and Escalator Electrical Equipment.
 - 3. NFPA 70 - National Electric Code.
- B. ADA: Provide passenger elevator in accordance with the requirements of Americans with Disabilities Act.

2.3 PASSENGER ELEVATORS (LU/LA)

- A. Basis of Design: Garaventa Elvora LU/LA Hydraulic and Electric Elevator.
 - 1. Capacity: 1,400 pounds (635 kg).
 - 2. Car Size: Maximum of 18 sq ft (1.67 sq m).
 - a. Style 1L: 48 x 54 inches (1220 x 1372 mm) with one side right sliding doors.
 - 3. Travel: 120 inches (3048 mm).
 - 4. Stops: 2.
 - 5. Speed: Nominal 30 ft per min (0.15 m/sec).
 - 6. Pit Depth: Minimum depths required.
 - a. In-line Geared Drive: 17 inches (432 mm).
 - 7. Total Overhead Clearance (Refuge Space):
 - a. In-line Geared Drive: 139 inches (3530 mm) above finished upper landing floor.
 - 8. Drive System: In-line geared.
 - a. Counterweighted geared drive.
 - b. Heavy duty car sling.
 - c. Roller guides running on 8 lb. per ft steel T-rails.
 - d. Motor mounted above rails.
 - e. Electronic control box. Location: Buckbox beside the Hall door.
 - f. Safety Features:
 - 1) Emergency back-up power with a manual lowering device.

- 2) Safety brake system.
- 3) Car operator with integral gate switch.
- 4) Automatic bi-directional floor leveling.
- 5) Emergency alarm button in car, Emergency keyed stop switch in car.
- 6) Final limit switch.
- 7) Overspeed governor.
9. Power Requirements: Per manufacturer's shop drawings.
 - a. A Separate 115 Volt, 15 Amp Circuit is required for car lighting.
10. Controls:
 - a. Garaventa-Design PLC Controller with integrated self-diagnostics.
 - b. Fully automatic push button at car and landings with Braille markings.
 - c. Automatic car light switch upon entry.
 - d. Digital floor indicator in car.
 - e. Car arrival lanterns in car door jamb.
 - f. Arrival gong.
11. Car and Hoistway Doors (W x H): Nominal 36 x 80 inch (914 x 2032 mm).
 - a. Two-speed.
 - b. Horizontal sliding.
12. Standard Features:
 - a. Car direction lantern comes with audio and visual signals.
 - b. Full height photo-electric door sensors.
 - c. Automatic home park feature; can be disengaged during installation if desired.
13. Options:
 - a. Integrated hands free telephone.
 - b. Fireman service (Phase 1).
 - c. Keyed hoistway access.
14. Machine Location: As indicated on the Drawings.

2.4 CAB DESIGN

- A. Handrail Finish:
 1. Stainless Steel: Brushed.
- B. Car Operating Panel Finish:
 1. Dove gray laminate.
 2. Powder coated white wall trim
- C. Floor: Linoleum.
 1. Forbo Marmoleum Real, "Eiger" 2629, .01" thick.
- D. Ceiling:
 1. White textured ceiling
- E. Lighting: Four recessed L.E.D. down lights
 1. Trim: White.
- F. Car Direction Lantern: Auto and visual signaling device indicating direction of travel and arrival at selected floor.
- G. Car Doors: Two speed horizontal sliding.
 1. When Opened (W x H): 36 x 80 inch (915 x 2032 mm) clearance.
 2. Sensors: Full height photo-electric door sensors.
 3. Paint to match panel trim
- H. Landing Doors: Prime for field painting.

2.5 HOISTWAY ENTRANCES

- A. Hoistway Entrances: Two speed horizontal doors.
 - 1. When Open (W x H): 36 x 80 inch (915 x 2032 mm) clearance.
 - 2. Sensors: Full height photo-electric door sensors.
- B. Hall Call Stations:
 - 1. Push Button: Keyless.
 - 2. Finish: Stainless Steel. Brushed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until preliminary work including hoistway, landings and machine space has been properly prepared.
- B. Verify the Following:
 - 1. Hoistway is constructed in accordance with ASME17.1 /CSA B-44 and local codes.
 - 2. Hoistway and machine room environments have a maintainable temperature between 50 and 90 degrees F (15 and 32 degrees C) and between 5 and 90 percent non-condensing.
 - 3. Hoistway shaft and openings are of correct size and within tolerance.
 - 4. Electrical power is available and of correct characteristics.
- C. If preliminary work is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install elevator in accordance with applicable regulatory requirements including ASME A17.1 /CSA B-44 and the manufacturer's instructions.
- B. Install system components and connect to building utilities.
- C. Accommodate equipment in space indicated.
- D. Startup equipment in accordance with manufacturer's instructions.
- E. Adjust for smooth operation.

3.4 FIELD QUALITY CONTROL

- A. Perform tests in compliance with ASME A17.1 /CSA B-44 and as required by authorities having jurisdiction.
- B. Schedule tests with agencies and Architect, Owner, and Contractor present.

3.5 FIELD SERVICES

- A. Obtain required permits to perform tests. Perform tests required by regulatory agencies.
- B. Schedule tests with agencies and Architect and Contractor present.
- C. Submit test and approval certificates issued by jurisdictional authorities.

3.6 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- B. Adjust automatic floor leveling feature at each floor to provide stopping zone of 1/4 inch (6 mm).

3.7 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components ready for inspection.

3.8 PROTECTION

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

END OF SECTION

SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Electronically Commutated Motors (ECM).

1.2 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.

PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
- B. 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.
- C. 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.
- D. 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.

2.2 APPLICATIONS

- A. Single phase motors for hot water recirculation: Electronically communicated motor.

2.3 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Manufacturers:

- 1. Taco, Inc.: www.tacocomfort.com.

PART 3 EXECUTION

3.1 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 220513

SECTION 220516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Pipe loops, offsets, and swing joints.

1.2 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. See Section 013000 - 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.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.2 FLEXIBLE PIPE CONNECTORS - COPPER 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.
 - 4. Unisource Manufacturing, Inc; Series 411, Bronze Braided Flex Connectors: www.unisource-mfg.com/#sle.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.

- D. Pressure Rating: 125 psi up to 2 inch.
- E. Maximum Service Temperature: 450 degrees F.
- F. End Connections: Flanged.
- G. Size: Use pipe sized units.
- H. Application: Copper piping.

2.3 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Hose Co. Inc; V-Loop: www.flexhose.com/#sle.
 - 2. Flex-Weld, Inc; Keflex Ke-Loop: www.kelcoind.com/#sle.
 - 3. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
 - 4. 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.

2.4 ACCESSORIES

- A. Pipe Alignment Guides:
 - 1. Manufacturers:

- a. Flex-Weld, Inc: www.kelcoind.com/#sle.

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MCPHERSON SQUARE LIBRARY RENOVATIONS AND PARK IMPROVEMENTS

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

- b. The Metraflex Company; PGQ Glide Riser Guide:
www.metraflex.com/#sle.
 - 2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.
- B. Swivel Joints:
- 1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

END OF SECTION 220516

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SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.
- C. Above-grade flashing panels.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.3 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.

1.4 SUBMITTALS

- A. See Section 013000 - 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.
- C. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Manufacturers:
 - 1. American Polywater Corporation; PZVR Watertight Wall Sleeves for Pipes: www.polywater-haufftechnik.com/#sle.
 - 2. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
- B. Vertical Piping:
 - 1. Sleeve Length: 2 inch above finished floor.
 - 2. Provide sealant for watertight joint.

PROJECT 52025E-06-01

MCPHERSON SQUARE LIBRARY RENOVATIONS AND PARK IMPROVEMENTS
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- 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. 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 078400 to prevent the spread of fire, smoke, and gases.

2.2 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. The Metraflex Company; MetraSeal: www.metraflex.com/#sle.
- 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.
 - D. Pipe Sleeve Material:
 - 1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 - 2. Masonry Structures: Sheet metal or fiber.
 - E. Wall Sleeve: Steel material with waterstop collar, and nailer end-caps.
- 2.3 Above-Grade Flashing Panels
- A. Manufacturers:
 - 1. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - B. Flashing Panels for Exterior Wall Penetrations: Premanufactured panel with elastomeric collar to seal around piping; select according to piping and facade materials installed.

PART 3 EXECUTION

3.1 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.

3.2 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. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Aboveground Piping:
 - a. Pack solid using mineral fiber complying 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. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

E. 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.

- F. 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.

3.3 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 220517

SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water meters.
- B. Pressure gauges.
- C. Thermometers.
- D. Pressure-temperature test plugs.

1.2 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 C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2024.
- E. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- F. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements. for additional provisions.

PART 2 PRODUCTS

2.1 WATER METERS

- A. Disc Water Meters:
 - 1. Manufacturers:

- a. Badger Meter; Recordall Disc Series: www.badgermeter.com/#sle.
 - b. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - c. Sensus, a Xylem brand: www.sensus.com/#sle.
- 2. Utility Connection Size: As indicated on drawings.
 - 3. Maximum Unidirectional Water Flow Capacity: As indicated on drawings.
 - 4. Remote Monitoring: Magnetic register with built-in AMR pulse output. To be coordinated with BAS for interconnection.
 - 5. Lead-free bronze alloy case and cap with hermetically-sealed mechanical register.
 - 6. Pressure and Temperature: Up to 150 psi and 140 degrees F.
 - 7. AWWA C700, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.
 - 8. Accessories: Provide downstream PT test plug and sight flow indicator.

2.2 PRESSURE GAUGES

A. Manufacturers:

- 1. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
- 2. Winters Instruments: www.winters.com/#sle.
- 3. Terice, H. O. Co..

B. Bourdon Tube for Liquids and Gases:

- 1. Dial Size and Cover: 4-1/2 inch diameter scale with glass or polycarbonate window.
- 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: Brass, 1/4 inch NPT female for noncorrosive service.

3. Pressure Snubber (Pulsation Damper): Brass, 1/4 inch NPT male.

2.3 THERMOMETERS

A. Manufacturers:

1. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
2. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
3. Winters Instruments: www.winters.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.

C. Thermometers - Adjustable Angle: 9 inch v-shape aluminum case with clear glass window scale, 6 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.

2.4 PRESSURE-TEMPERATURE TEST PLUGS:

A. Manufacturers:

1. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
2. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
3. Terice, H. O. Co.

B. 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.

C. Wetted Materials per Temperature Range:

1. Up to 200 degrees F: Brass probe with neoprene core.

D. Accessories: Brass, lever-handle cock and snubber-filter.

E. 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

3.1 INSTALLATION

A. 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. Include siphons on high temperature systems and select type according to service rating.
4. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.

3.2 SCHEDULES

A. Pressure Gauges, Location and Scale Range:

1. Pumps, 0 to 160 psi.
2. Expansion tanks, 0 to 160 psi.
3. Pressure reducing valves, 0 to 160 psi.
4. Backflow preventers, 0 to 160 psi.

B. Stem Type Thermometers, Location and Scale Range:

1. Domestic hot water supply and recirculation, 0 to 240 degrees F.
2. Domestic cold water, 0 to 100 degrees F.

END OF SECTION 220519

SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ball valves.
- B. Check valves.
- C. Gate valves.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- D. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.4 SUBMITTALS

- A. See Section 013000 - 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. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

PART 2 PRODUCTS

2.1 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, gate.

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2. Swing Check (Pump Outlet):
 - a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

C. Domestic, Hot and Cold Water Valves:

1. 2 inch and Smaller:
 - a. Bronze and Brass: Provide with solder-joint, threaded, or press connection-joint ends.
 - b. Ball: One piece, full port, brass or bronze with brass trim.
 - c. Bronze Swing Check: Class 125, bronze disc.

2.2 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.
- C. Valve Actuator Types:
- D. Valve-End Connections:
 1. Threaded End Valves: ASME B1.20.1.
 2. Solder Joint Connections: ASME B16.18.
- E. General ASME Compliance:

2.3 BRASS, BALL VALVES

- A. Two Piece, Full Port with Brass 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.
 6. Ball: Chrome-plated brass.
 7. Operator: Lockable handle and memory stop.

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8. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; 410A: www.fnw.com/#sle.
 - c. Mueller Streamline, Co; Series 7700: www.muellerstreamline.com/#sle.
 - d. NIBCO INC: www.nibco.com/#sle.

B. Two Piece, Full Port with Press Connections:

1. WOG Rating: 250 psi.
2. Body: Forged brass.
3. Seats: EPDM.
4. Ball: Chrome-plated brass.
5. Blowout Proof Stem: Forged brass.
6. Operator: Provide lockable handle.
7. Maximum Service Temperature: 250 degrees F.
8. Manufacturers:
 - a. Mueller Streamline, Co; Series 7700: www.muellerstreamline.com/#sle.
 - b. Viega, LLC.

2.4 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.

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6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. FNW; X450: www.fnw.com/#sle.
 - c. NIBCO INC: www.nibco.com/#sle.

2.5 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.
7. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. NIBCO INC: www.nibco.com/#sle.

PART 3 EXECUTION

3.1 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.

3.2 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. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION 220523

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SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 Section Includes

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Pipe rollers and roller supports.
- F. Pipe supports, guides, shields, and saddles.
- G. Anchors and fasteners.

1.2 Related Requirements

- A. Section 055000 - Metal Fabrications.

1.3 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; 2023.
- 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; 2025a.

- I. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
 - J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
 - K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
 - L. MFMA-4 - Metal Framing Standards Publication; 2004.
 - 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.
- 1.4 Submittals
- A. See Section 013000 - 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.
- 1.5 Quality Assurance
- A. Comply with applicable building code.

PART 2 PRODUCTS

2.1 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. Materials for Metal Fabricated Supports: Comply with Section 055000.
 - 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.

- D. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.2 Prefabricated Trapeze-Framed Systems

A. Prefabricated Trapeze-Framed Metal Strut Systems:

1. Manufacturers:
 - a. Anvil International, LLC: www.asc-es.com/#sle.
 - b. Gripple, Inc; Fast Track - Standard: www.gripple.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
3. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

2.3 Strut Systems for Pipe or Equipment Support

A. Strut Channels:

1. Manufacturers:
 - a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. 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. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7821: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.4 Beam Clamps

- A. Manufacturers:
 1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 2. FNW; 7201: www.fnw.com/#sle.
 3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
- B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- C. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- 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.

2.5 Pipe Hangers

- A. Clevis Hangers, Adjustable:
 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7005: www.fnw.com/#sle.
 2. Copper Tube: MSS SP-58 type 1, copper coated steel.
 3. Standard-Duty: MSS SP-58 type 1, stainless steel.

2.6 Pipe Clamps

- A. Riser Clamps:
 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.

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2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
3. MSS SP-58 type 1 or 8, carbon steel or steel with plain, stainless steel, or zinc plated finish.
4. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

B. Extension Split Pipe Clamp:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
4. Provide hanger rod and nuts of the same type and material for a given pipe run.
5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

D. Strut Clamps:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7815: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with zinc or copper finish.

2.7 Pipe Rollers and Roller Supports

A. Manufacturers:

1. ASC Engineered Solutions: www.asc-es.com/#sle.
2. FNW; 7902: www.fnw.com/#sle.

B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.

- D. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.8 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. 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.
- C. 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.

2.9 Anchors and Fasteners

- A. Manufacturers - Mechanical Anchors:

1. FNW; 7502: www.fnw.com/#sle.
 2. Hilti, Inc: www.us.hilti.com/#sle.
 3. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 4. Powers Fasteners, Inc: www.powers.com/#sle.
 5. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- B. Manufacturers - Powder-Actuated Fastening Systems:
1. Hilti, Inc: www.us.hilti.com/#sle.
 2. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 3. Powers Fasteners, Inc: www.powers.com/#sle.
 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- C. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- D. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- E. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 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

3.1 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.

3.2 Installation

- A. Install products in accordance with manufacturer's instructions.

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- 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. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. 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.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

END OF SECTION 220529

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.2 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.4 SUBMITTALS

- A. See Section 013000 - 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. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 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.

C. Pipe Markers: 3/4 inch diameter and higher.

2.2 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.

B. Description: Laminated piece with up to three lines of text.

1. Letter Color: Black.
2. Letter Height: 1/4 inch.
3. Nameplate Material:
 - a. Flexible: Vinyl with adhesive backing per ASTM D709.
 - b. Metal: Brass with center-side holes for screw fastening.

2.3 TAGS

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. Seton Identification Products: www.seton.com/#sle.

B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, stamped or engraved, 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.

2.4 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. 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. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E. Identification Scheme, ASME A13.1:

1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
 - b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
 - c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
2. Secondary: Color scheme per fluid service.
 - a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
3. Tertiary: Other Details.
 - a. Directional flow arrow.

PART 3 EXECUTION

3.1 PREPARATION

- #### A. Degrease and clean surfaces to receive identification products.

3.2 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. 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.

END OF SECTION 220553

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible elastomeric cellular insulation.
- B. Glass fiber insulation.
- C. Jacketing and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- E. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- H. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

PART 2 PRODUCTS

2.1 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.

2.2 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. Johns Manville Corporation: www.jm.com/#sle.
 - 2. Knauf Insulation: www.knaufinsulation.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid, preformed pipe insulation, noncombustible.
 - 1. K Value: ASTM C177, 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. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA; AEROFLEX Self-Seal: www.aeroflexusa.com/#sle.
 - 2. Armacell LLC; AP ArmaFlex: www.armacell.us/#sle.
 - 3. K-Flex USA LLC; Insul-Tube: 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: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.4 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
 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: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
- B. Reinforced Tape:
 1. Manufacturers:
 - a. Ideal Tape Co., Inc: www.idealtape.com/#sle.
 2. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 3. Comply with UL 723 or ASTM E84.
 4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 5. Finish: Match insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.

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- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. 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.
- C. 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.
 - 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.

3.3 SCHEDULES

- A. Plumbing Systems:
 - 1. Domestic Hot Water Supply:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
 - b. Flexible Elastomeric Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
 - 2. Domestic Hot Water Recirculation:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.

- b. Flexible Elastomeric Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch (.
- 3. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
 - b. Flexible Elastomeric Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
- 4. Roof Drainage Run Horizontal at Roof Level:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
 - b. Flexible Elastomeric Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.

END OF SECTION 220719

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SECTION 221005
PLUMBING PIPING

PART 1 GENERAL

1.1 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. Pipe hangers and supports.
- G. Balancing valves.
- H. Pressure reducing valves.
- I. Pressure-temperature valves.
- J. Strainers.

1.2 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting.
- B. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- C. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.
- D. Section 220719 - Plumbing Piping Insulation.
- E. Section 330110.58 - Disinfection of Water Utility Piping Systems.

1.3 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2025).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.

- E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- F. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; 2021.
- G. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.
- H. 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.
- I. ASSE 1003 - Water Pressure Reducing Valves for Potable Water Distribution Systems; 2023.
- J. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2025.
- K. ASTM B32 - Standard Specification for Solder Metal; 2020.
- L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- N. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.
- O. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- P. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- Q. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- R. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- S. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- T. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- U. 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.
- V. 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.

- W. IAPMO (UPC) - Uniform Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- X. IAPMO/ANSI/CAN Z1117 - Standard for Press Connections; 2022.
- Y. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Z. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- AA. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- BB. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.4 SUBMITTALS

- A. See Section 013000 - 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. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- D. Project Record Documents: Record actual locations of valves.

1.5 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.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 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.

2.3 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.
- B. Copper Tube: ASTM B306, DWV.
 - 1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, solvent.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
 - 3. 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:
 - 1) Apollo Valves: www.apollovalves.com/#sle.
 - 2) Mueller Streamline, Co; PRS: www.muellerstreamline.com/#sle.

3) NIBCO INC; Press System: www.nibco.com/#sle.

4) Viega, LLC.

2.6 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. Flanges for Pipe Sizes Over 1 inch:

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. No-Hub Couplings:

1. Testing: In accordance with ASTM C1277 and CISPI 310.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.
5. Manufacturers:
 - a. Dallas Specialty & Mfg Co: www.dallasspecialty.com/#sle.
 - b. Ideal Clamp Products, Inc; Standard: www.idealtridon.com//#sle.
 - c. ANACO-Husky.

D. 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.
5. Manufacturers:
 - a. Dallas Specialty & Mfg Co: www.dallasspecialty.com/#sle.

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- b. Ideal Clamp Products, Inc; Yellow Shield Heavy Duty:
www.idealtridon.com/#sle.
- c. ANACO-Husky.

2.7 PIPE HANGERS AND SUPPORTS

- A. See Section 220529 for additional requirements.
- B. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.

2.8 BALANCING VALVES

- A. Manufacturers:
 - 1. Anvil International: www.anvilintl.com/#sle.
 - 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 - 3. Griswold Controls: www.griswoldcontrols.com/#sle.
 - 4. NIBCO INC: www.nibco.com/#sle.
 - 5. Taco, Inc: www.taco-hvac.com/#sle.
- B. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch:
 - 1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi, minus 4 to 250 deg F WOG service.
- D. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.9 PRESSURE REDUCING VALVES

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com/#sle.
2. Watts Regulator Company: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC; 500XL3: www.zurn.com/#sle.

B. 2 inch and Smaller:

1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
2. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 5 to 50 psi.
 - b. Connected into brass or bronze pilot piping and fittings.
 - c. Fixed flow restrictor, pressure gauges, and isolation valves.

2.10 PRESSURE-TEMPERATURE VALVES

A. Manufacturers:

1. Cla-Val Co: www.cla-val.com/#sle.
2. Watts Regulator Company: www.wattsregulator.com/#sle.

- B. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.11 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. Green Country Filter Manufacturing: www.greencountryfilter.com/#sle.
3. NIBCO INC: www.nibco.com/#sle.
4. WEAMCO: www.weamco.com/#sle.
5. Watts Water Technologies; a Watts company.

B. Size 1/2 inch to 3 inch:

1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi, 250 deg F WOG service.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 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.

3.3 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 220516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 1. See Section 220719.
- H. Provide access where valves and fittings are not exposed.
- I. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
 1. See Section 099123 for painting of interior plumbing systems and components.
- J. 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.

K. Sleeve pipes passing through partitions, walls, and floors.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 330110.58.

3.5 SCHEDULES

A. Pipe Hanger Spacing:

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.

END OF SECTION 221005

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SECTION 221006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Washing machine outlet boxes.
- F. Backwater valves.
- G. Backflow preventers.
- H. Water hammer arrestors.
- I. Mixing valves.
- J. Trap primers.

1.2 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor Drains; 2022.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- D. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- E. ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems; 2023.
- F. ASSE 1018 - Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied; 2023.
- G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.
- H. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.

- I. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- J. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- K. PDI-WH 201 - Water Hammer Arresters; 2017.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Operation Data: Indicate frequency of treatment required for interceptors.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- F. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Loose Keys for Outside Hose Bibbs: One.
 - 3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

- A. Manufacturers:
 - 1. Josam Company: www.josam.com/#sle.
 - 2. Jay R. Smith Mfg. Co.
 - 3. WATTS.
 - 4. Zurn Industries, LLC.

B. Area Drains:

1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Square nickel-bronze.
4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with waterproofing flange.
5. Manufacturers:
 - a. Zurn Industries, LLC: www.zurn.com/#sle.

C. Floor Drains:

D. Floor Drain (FD-1):

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and square, adjustable nickel-bronze strainer.

E. Floor Drain (FD-2):

1. ASME A112.6.3; stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable stainless steel strainer.

2.3 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Josam Company: www.josam.com/#sle.
3. MIFAB, Inc; C1100-R: www.mifab.com/#sle.
4. Zurn Industries, LLC: www.zurn.com/#sle.

B. Cleanouts at Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

C. Cleanouts at Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- D. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Watts Regulator Company: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Interior Hose Bibbs:

1. Bronze or brass with mounting flange, replaceable seat, hose thread spout, and integral or add-on vacuum breaker complying with ASSE 1011.
2. Finishes:
 - a. Exposed Locations: Polished chrome.
 - b. Mechanical and Equipment Rooms: Polished chrome or rough bronze.
 - c. Service Areas: Polished chrome.
3. Operation:
 - a. Exposed Locations: Operating key.
 - b. Mechanical and Equipment Rooms: Handwheel, T-handle, or lever.
 - c. Service Areas: Operating key.

2.5 HYDRANTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Murdock Mfg.
3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Wall Hydrants 9WH-1:

1. ASSE 1019, freeze resistant, self-draining, hose thread spout, and integral vacuum breaker.

- a. Installation: Lockable recessed box.
 - b. Finish: Polished chrome.
 - c. Operation: Operating key.
- C. Interior Wall Hydrants (WH-2):
 - 1. ASSE 1019, hose thread spout, and integral vacuum breaker.
 - a. Installation: Lockable recessed box.
 - b. Finish: Polished chrome.
 - c. Operation: Operating key.

2.6 WASHING MACHINE OUTLET BOXES

- A. Manufacturers:
 - 1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
 - 2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Description: Plastic preformed rough-in box with brass quarter-turn ball valves, socket for 2 inch waste, and slip-in finishing cover.
- C. Provide fire-rated outlet-box assembly for installation in 1- and 2-hour rated walls.
- D. Accessories:
 - 1. Water-hammer arrestors.
 - 2. Support brackets for installation between framing studs.

2.7 BACKWATER VALVES

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - 2. Watts Regulator Company: www.wattsregulator.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Cast Iron Backwater Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.

2.8 BACKFLOW PREVENTERS

A. Manufacturers:

1. Watts Regulator Company, a part of Watts Water Technologies:
www.wattsregulator.com/#sle.

B. Reduced Pressure Backflow Preventer Assembly (BFP-1):

1. ASSE 1013; lead free bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
2. Size: 2 inch assembly with threaded gate valves.
3. Maximum Working Parameters: 175 psi at 180 degrees F.
4. Accessories: Provide air gap fitting, lead-free Y-strainer, and test cocks.

C. Reduced Pressure Backflow Preventer Assembly (BFP-1):

1. ASSE 1013; lead free bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
2. Size: 3/4 inch assembly with threaded gate valves.
3. Maximum Working Parameters: 175 psi at 180 degrees F.
4. Accessories: Provide air gap fitting, lead-free Y-strainer, and test cocks.

2.9 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Precision Plumbing Products.
3. Watts Regulator Company, a part of Watts Water Technologies:
www.wattsregulator.com/#sle.
4. Zurn Industries, LLC: www.zurn.com/#sle.

B. Water Hammer Arrestors:

1. Copper construction, piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.10 Mixing Valves

A. Thermostatic Master Mixing Valves:

1. Manufacturers:
 - a. Leonard Valve Company: www.leonardvalve.com/#sle.
 - b. Resideo Technologies, Inc: www.resideo.com/#sle.
 - c. Watts Water Technologies; POWERS: www.watts.com/#sle.
2. Valve: ASSE 1017, bronze or brass body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment.
3. Accessories:
 - a. Strainer stop checks on inlets.

B. Water Temperature Limiting Valves:

1. Manufacturers:
 - a. Leonard Valve Company: www.leonardvalve.com/#sle.
 - b. Watts Water Technologies; POWERS: www.watts.com/#sle.
2. Valve: ASSE 1070, bronze or brass body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment with high-temperature limit stop; integral check valves with strainer screens on inlets.

2.11 Trap Primers

A. Water-Supplied Trap Primers:

1. Description: ASSE 1018, bronze or brass body, water-supplied, pressure-drop activated trap primer with internal filter screen and integral vacuum breaker.
2. Operating Pressure Range: 20 to 80 psi.
3. Activation Pressure Drop: 3 psi.
4. Accessories:
 - a. Shutoff valve on inlet.
 - b. Manufacturer's distribution unit with two outlet ports.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- E. Pipe relief from backflow preventer to nearest drain.
- F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.

END OF SECTION 221006

SECTION 221119 – FREEZE-PROOF FLUSH-MOUNTED GROUND HYDRANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Freeze-proof, concealed-outlet, flush-mounted ground hydrants (park hose bibs) for potable water service.

B. Related Requirements:

1. Section 331416 – Site Water Utility Distribution Piping: Pressure testing of ground hydrants.
2. Section 331417 – Site Water Service Utility Laterals: Piping, trenching, backfilling, and compaction requirements.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME A112.21.3M – Hydrants for Utility and Maintenance Use.
2. ASME B1.20.7 – Hose Coupling Screw Threads.

B. NSF International:

1. NSF 61 – Drinking Water System Components – Health Effects.
2. NSF 372 – Drinking Water System Components – Lead Content.

C. American Water Works Association (AWWA):

1. AWWA C651 – Disinfecting Water Mains.

D. Philadelphia Water Department (PWD): Standard Specifications and Standard Details (most recent revision or amendment).

E. American Society of Sanitary Engineering (ASSE):

1. ASSE 1011 – Hose Connection Vacuum Breakers.

1.3 COORDINATION

A. Coordinate Work of this Section with installation of water service laterals specified in Section 331417 and with pavement and hardscape installation.

B. Ground hydrant box tops shall be set flush with finish grade or pavement surface. Coordinate final setting elevation with grading plan and paving contractor.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer information regarding component materials, fittings, assembly and parts diagram, dimensions, and accessories.

B. Shop Drawings: Indicate hydrant locations, finish grade elevations at each hydrant, inlet connection size, and depth of bury.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements, including NSF 61 and NSF 372 compliance.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Field Quality-Control Submittals: Indicate results of pressure testing and disinfection.

F. Qualifications Statement: Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ground hydrants and invert elevations of inlet connections.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish two (2) operating keys to Owner at project closeout.

1.7 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372. Confirm lead-free construction compliance with manufacturer prior to procurement.
- B. Perform Work according to Philadelphia Water Department Standard Specifications and Standard Details (most recent revision).
- C. Master Plumber: All connections to the potable water system shall be made by or under the direct supervision of a Master Plumber licensed in the City of Philadelphia, consistent with Section 331417.
- D. Maintain one copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Seal hydrant ends to prevent entry of foreign matter during transit.
 - 2. Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NONFREEZE FLUSH-MOUNTED GROUND HYDRANTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide J.R. Smith Manufacturing Model 5950 (3/4-inch inlet) or Model 5951 (1-inch inlet), as required by the pipe size shown on the Drawings, or comparable product by one of the following:

- 1. Josam Company.
- 2. MIFAB, Inc.
- 3. Murdock Manufacturing; a Division of Morris Group International.
- 4. Prier Products, Inc.
- 5. Watts Water Technologies.
- 6. Woodford Manufacturing Company.
- 7. Zurn Industries, LLC.
- 8. Approved equivalent.

- B. Standard: ASME A112.21.3M.

- C. Description:

- 1. Type: Nonfreeze, concealed-outlet, flush-mounted ground hydrant with box.
- 2. Operation: Loose key (operating key required to open).
- 3. Barrel: Automatic drain after use — drain hole opens when valve is closed to drain water from barrel above frost line.

- D. Materials:

- 1. Body/Casing: Brass or bronze.
- 2. Main Valve: Bronze.
- 3. Drain Valve: Bronze.
- 4. Operating Rod: Stainless steel.

5. Box and Cover: Ductile iron.

E. Connections:

1. Inlet Size: 3/4 inch or 1 inch as indicated on Drawings.
2. Inlet Type: Threaded.
3. Outlet: 3/4-inch garden-hose thread complying with ASME B1.20.7.
4. Drain Port: Into gravel sump — do not connect to drain piping.

F. Casing and Operating Rod: Of length required to bury valve a minimum of 12 inches below the frost line (minimum 42 inches below finish grade in Philadelphia), or as indicated on Drawings, whichever is greater.

G. Box:

1. Type: Flush-mounted, sized to accept operating key access.
2. Cover: Ductile iron, set flush with finish grade or pavement surface.
3. Cover Marking: Stamped or cast "WATER" or as required by PWD.

H. Backflow Prevention: Provide hose-connection vacuum breaker complying with ASSE 1011 at each hydrant outlet, or provide inline backflow preventer in supply piping to hydrant system. Coordinate method with plumbing engineer.

I. Accessories:

1. Operating Key: Furnish two (2) keys per Article 1.6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Verify that elevations prior to excavation and installation of ground hydrants are as indicated on Drawings.
- C. Verify that water service lateral piping is installed and pressure tested prior to connecting ground hydrant.

3.2 PREPARATION

- A. Locate, identify, and protect from damage utilities to remain.
- B. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
 1. Notify Architect/Engineer not less than three (3) days in advance of proposed utility interruption.
 2. Do not proceed without written permission from Architect/Engineer.

3.3 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 331417 – Site Water Service Utility Laterals.
- B. Install ground hydrants in conjunction with pipe laying, with inlet connection at the depth required by Article 2.1F.
- C. Drain Sump: Provide 1 cubic foot minimum of clean AASHTO #57 crushed gravel around drain hole. Do not block drain hole or connect drain to piping.
- D. Plumb and Level: Set ground hydrant plumb. Set box flush with finish grade or pavement surface at elevation indicated on Drawings.
- E. Frost Protection: Ensure main valve is buried at the depth required by Article 2.1F. Do not reduce bury depth without written approval from Architect/Engineer.
- F. Backflow Preventer: Install vacuum breaker at outlet or inline backflow preventer as specified in Article 2.1H, prior to any operational use of the hydrant.

G. After main-line pressure testing, flush ground hydrants and check for proper drainage. Operate each hydrant through a full open-and-close cycle and verify that barrel drains fully when closed.

H. Disinfection: Disinfect ground hydrant and associated piping in accordance with the Philadelphia Water Department Standard Specifications and Standard Details (most recent revision), PWD Standard W-22, and AWWA C651. Minimum contact time 24 hours per AWWA C651.

3.4 FIELD QUALITY CONTROL

A. Pressure Testing: Pressure test ground hydrants with water service laterals as specified in Section 331416 – Site Water Utility Distribution Piping.

B. Operational Test: After pressure testing and disinfection, test each hydrant for:

1. Smooth valve operation with operating key.
2. Full flow at outlet.
3. Complete drainage of barrel after closing — confirm no standing water remains in casing within 30 minutes of closing.
4. Proper function of vacuum breaker or backflow preventer.

C. If any test indicates defective installation or materials, repair or replace and retest at no additional cost to Owner.

END OF SECTION 221119

SECTION 221123
DOMESTIC WATER PUMPS

PART 1 GENERAL

1.1 Section Includes

- A. Circulators.

1.2 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; 2024.

PART 2 PRODUCTS

2.1 Circulators

- A. Manufacturers:

- 1. Bell & Gossett, a Brand of Xylem, Inc: www.xylem.com/#sle.
- 2. Grundfos Pumps Corporation: www.grundfos.com/#sle.
- 3. Taco, Inc: www.tacomfort.com/#sle.

- B. Casing: Stainless steel with composite 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: Flange connection.

- F. Maximum Discharge Pressure: 145 psi.

- G. Minimum Inlet Pressure: 0.5 psi at 140 degrees F.

- H. Motor: 1,750 rpm, ECM duty with flexible coupling.

- I. Service Temperature Range: Minus 30 to 250 degrees F.

- J. Controls: Provide aquastat set for high-temp cutoff, electric plug, and illuminated hand switch.

PART 3 EXECUTION

3.1 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. Ensure that small pressure gauges are installed on both upstream and downstream ends.
- D. 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.
- E. 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.

END OF SECTION 221123

SECTION 221323
SANITARY WASTE INTERCEPTORS

PART 1 GENERAL

1.1 Section Includes

- A. Solids interceptors.

1.2 Related Requirements

- A. Section 221005 - Plumbing Piping.

1.3 Submittals

- A. See Section 013000 - 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, capabilities, rated flow rates, retention capacities, rough-in requirements, location and sizes of piping connections, service and access locations, and manufacturer-provided and field-installed accessories.
- C. Shop Drawings: Provide for products listed below. Indicate interceptor assembly, including arrangements of adjacent sanitary waste and vent piping. Indicate clearances required for service and maintenance. Show inlet and outlet inverts for buried or recessed interceptors and for interceptors installed in sub-slab locations.
 - 1. Solids interceptors.
- D. Operation and Maintenance Data: Provide for products listed below.
 - 1. Solids interceptors.
- E. Project Record Documents: Indicate installed interceptor assembly, including adjacent sanitary waste and vent piping. Show inlet and outlet inverts for buried or recessed interceptors and for interceptors installed in sub-slab locations

PART 2 PRODUCTS

2.1 General Requirements

- A. Source Limitations: Furnish interceptors of same kind by same manufacturer.

2.2 Solids Interceptors

- A. Inline Solids Interceptors:

- 1. Manufacturers:

- a. Zurn Industries, LLC: www.zurn.com/#sle.
- 2. Description: Inline or trap-style interceptor in epoxy-coated cast iron or epoxy-coated steel with lift-out sediment bucket or removable screens and gasketed bolted lid.

PART 3 EXECUTION

3.1 Examination

- A. Verify field measurements are as indicated.
- B. Verify rough-ins for field connections match sizes and locations shown on drawings.
- C. Verify field piping connections are at inverts indicated on drawings.
- D. Verify conditions are satisfactory for installation prior to starting work.

3.2 Installation

- A. Install products in accordance with manufacturer's instructions, adopted code, and requirements of local authorities having jurisdiction.
- B. Install interceptors level and plumb.
- C. Refer to drawings and see Section 221005 for requirements for waste and vent piping to and from interceptors.
- D. Support waste and vent piping independently from interceptors.
- E. Vent interceptors in accordance with adopted code and with requirements of local authorities having jurisdiction.
- F. Install interceptors with clearance for access and maintenance, including removal of sediment buckets, screens, and strainers.

3.3 Cleaning

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Clean debris from within interceptors.
- C. Clean lids and manhole covers to remove dirt, debris, and other foreign material.

3.4 Protection

- A. Protect installed interceptors from accumulating dirt and debris through remainder of construction.

B. Protect installed products from damage due to subsequent construction operations.

END OF SECTION 221323

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SECTION 223000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Commercial electric water heaters.
- B. Diaphragm-type compression tanks.

1.2 REFERENCE STANDARDS

- A. 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.
- B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

1.3 SUBMITTALS

- A. See Section 013000 - 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 for the following equipment:
 - a. Water heaters.
 - 2. Provide plans and elevations showing equipment assembly, including fabrication and installation details. Show location and sizes of connections.
 - a. Indicate anchors, attachments, and lifting points.
 - b. Include arrangements of adjacent piping and valves.
 - 3. Indicate clearances required for service, access, maintenance, and replacement of internal components.
- D. Project Record Documents: Record actual locations of components.

- 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.

1.4 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for domestic water heaters. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 WATER HEATERS

- A. Manufacturers:
 - 1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
 - 2. Bradford White Corporation: www.bradfordwhite.com/#sle.
 - 3. Rheem Manufacturing Company: www.rheem.com/#sle.
- B. Commercial Electric Water Heaters:
 - 1. Type: Factory-assembled and wired, electric, vertical storage.
 - 2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
 - 3. Performance:
 - a. Storage Capacity: 120 gal.
 - b. Number of Heating Elements: 3.
 - c. Minimum Recovery Rate: 184 gph with 100 degrees F temperature rise.
 - d. Maximum Working Pressure: 150 psig.
 - 4. Electrical Characteristics:
 - a. 208 VAC, three phase, 60 Hz.
 - 5. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2 inch glass fiber; enclosed with 16 gauge, 0.0598 inch steel jacket; baked enamel finish.

6. 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.
7. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.2 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.

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 psig, 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 psig.

PART 3 EXECUTION

3.1 Examination

A. Field-Erected Water Tanks:

1. Verify anchoring slabs, foundations, and structures ready to receive equipment.
2. Verify tank components free from damage and corrosion.
3. Verify pipe connection flanges are completely clean without signs of damage or degradation.

3.2 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.

B. Coordinate system, equipment, and piping work with applicable electrical, fuel, gas, vent, drain, and waste support interconnections as included or provided by other trades.

C. Domestic Hot Water Storage Tanks:

1. Clean and flush prior to delivery to site. Seal until pipe connections are made.

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SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tank type water closets.
- B. Lavatories.
- C. Sinks.
- D. Supply stops.
- E. Under-lavatory pipe supply covers.
- F. Bi-level, electric water coolers.
- G. Mop sinks.

1.2 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 A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2024.
- G. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.
- H. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 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; 2024.
- L. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.3 SUBMITTALS

- A. See Section 013000 - 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. For electrically powered fixtures, include electrical characteristics.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Faucet Washers: One set of each type and size.
 - 3. Extra Lavatory Supply Fittings: One set of each type and size.
 - 4. Extra Toilet Seats: One of each type and size.

1.4 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.1 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.

2.2 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.

2.3 TANK TYPE WATER CLOSETS

- A. Manufacturers:
 - 1. American Standard: www.americanstandard-us.com/#sle
PROJECT 52025E-06-01
MCPHERSON SQUARE LIBRARY RENOVATIONS AND PARK IMPROVEMENTS
PLUMBING FIXTURES

2. Kohler Company: www.kohler.com/#sle.
3. Sloan Valve: www.sloanvalve.com/#sle.
4. Zurn Industries, LLC: www.zurn.com/#sle.

B. Floor-Mounted Bowl:

1. ASME A112.19.2; siphon jet, vitreous china, 16.5 inches high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.
2. Water Consumption: 1.1 gal per flush, maximum.
3. Handle Height: 44 inches or less.
4. Trapway Outlet: 4 inch.

C. Toilet Seats:

1. Plastic: Solid, white, elongated, open front, hinged seat cover, extended back with self-sustaining hinges, and brass bolts with covers.
2. Manufacturers:
 - a. Bemis Manufacturing Company: www.bemismfg.com/#sle.
 - b. PROFLO; Camas - Slow Close, Easy Clean, Heavy Duty: www.ferguson.com/#sle.

2.4 LAVATORIES

A. Manufacturers:

1. American Standard: www.americanstandard-us.com/#sle
2. Kohler Company: www.kohler.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.

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. 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, 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 Industries, LLC; Z1231: www.zurn.com/#sle.

C. Supply Faucet:

- 1. Deck Mounted Faucet Manufacturers:
 - a. American Standard: www.americanstandard-us.com/#sle
 - b. Kohler Company: www.kohler.com/#sle.
 - c. Zurn Industries, LLC; Aqua Sense Series: www.zurn.com/#sle.
- 2. Two-Handle, Supply Faucet: ASME A112.18.1; deck-mount, ceramic cartridge disc valve, and maximum flow of 0.35 gpm. Brushed nickel finish.

D. Thermostatic Mixing Valve:

- 1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.

E. Accessories:

- 1. Offset waste with perforated open strainer.
- 2. Chrome-plated 17 gauge, 0.0538 inch brass P-trap with clean-out plug, tailpiece, and escutcheon.
- 3. Wheel handle stops.
- 4. Rigid supplies.

2.5 SINKS

A. Manufacturers:

- 1. Kohler Company: www.kohler.com/#sle.
- 2. Elkay.
- 3. Just Manufacturing.

- B. Undermount-Installed Single Compartment Bowl:
 - 1. ASME A112.19.3, stainless steel, 18 gauge, 0.050 inch, type 304 stainless steel.
 - 2. Undercoated bottom sound deadening pads.
 - 3. Outside Dimension: 23-1/2 by 18-1/4 by 4-3/8 inch.
 - 4. Drain: 3-1/2 inch, stainless steel with strainer, crumb cup, and tailpiece.
- C. Kitchen Faucets:
 - 1. Manufacturers:
 - a. American Standard: www.americanstandard-us.com/#sle
 - b. Kohler Company: www.kohler.com/#sle.
 - c. Elkay.
- D. Commercial Kitchen, Double Lever Handle Faucet:
 - 1. Type: Deck-mount faucet with mounting plate.
 - 2. Spray Type: Full stream spray at 1.5 gpm, maximum.
 - 3. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.
 - 4. Materials: Stainless steel disc valve on brass body with polished chrome finish.
- E. Accessories: Provide braided water supply lines, slip-joint p-trap, and stainless steel basket strainer.

2.6 Supply Stops

- A. Manufacturers:
 - 1. SharkBite, a brand of Reliance Worldwide Corporation: www.sharkbite.com/#sle.
 - 2. Jones Stephens: www.jonesstephens.com/#sle.
 - 3. PROFLO: www.ferguson.com/#sle.
- B. Description: ASME A112.18.1, quarter-turn full-port brass ball valve.
- C. Operation: Handwheel or T-handle.
- D. Finish: Polished chrome.
- E. End Connections: Provide supply stops with end connections to match rough-in piping.

- F. Maximum Working Pressure: 125 psi.
- G. Working Temperature Range: 33 to 160 degrees F.

2.7 UNDER-LAVATORY PIPE SUPPLY COVERS

A. Manufacturers:

- 1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.

B. General:

- 1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
- 2. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - b. Comply with ICC A117.1.
- 3. Color: High gloss white.
- 4. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

2.8 BI-LEVEL, ELECTRIC WATER COOLERS

A. Manufacturers:

- 1. Elkay Manufacturing Company: www.elkay.com/#sle.
- 2. Haws Corporation: www.hawesco.com/#sle.
- 3. Oasis International: www.oasiscoolers.com/#sle.

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.

2.9 MOP SINKS

A. Terrazzo Mop Sink Manufacturers:

1. Acorn Engineering Company: www.acorneng.com/#sle.
2. American Bath Group: www.americanbathgroup.com/#sle.
3. Fiat Products.

B. Material: Precast terrazzo composed of marble chips cast in Portland cement.

C. Type: Rectilinear, drop front.

D. Grid strainer: Stainless steel; integral; removable.

E. Dimensions: As indicated on drawings.

F. Two-Lever Handle Service Faucet:

1. Manufacturers:

- a. Acorn Engineering Company: www.acorneng.com/#sle.
- b. American Standard: www.americanstandard-us.com/#sle
- c. Elkay Manufacturing Company: www.elkay.com/#sle.

2. Type: Wall-mount spout faucet with union inlets and mounting plate.

3. Spray Type: Full stream spray at 1.8 gpm, maximum.

4. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.

5. Materials: Ceramic disc cartridge valve on brass body with polished chrome finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.4 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

- A. Clean plumbing fixtures and equipment.

3.6 SCHEDULES

- A. Fixture Rough-In

1. Water Closet (Flush Valve Type):

- a. Cold Water: 1 Inch.
- b. Waste: 4 Inch.
- c. Vent: 2 Inch.

2. Lavatory:

- a. Hot Water: 1/2 Inch.
- b. Cold Water: 1/2 Inch.
- c. Waste: 1-1/2 Inch.
- d. Vent: 1-1/4 Inch.

3. Sink:

- a. Hot Water: 1/2 Inch.
 - b. Cold Water: 1/2 Inch.
 - c. Waste: 2 Inch.
 - d. Vent: 1-1/2 Inch.
4. Service Sink:
- a. Hot Water: 1/2 Inch.
 - b. Cold Water: 1/2 Inch.
 - c. Waste: 3 Inch.
 - d. Vent: 3 Inch.
5. Drinking Fountain:
- a. Cold Water: 1/2 Inch.
 - b. Waste: 2 Inch.
 - c. Vent: 2 Inch.

END OF SECTION 224000

SECTION 230130.51
HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of existing and new HVAC duct system, equipment, and related components.
- B. Testing and inspection agency employed by Owner.

1.2 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- B. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.
- C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- D. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Project Cleanliness Evaluation and Cleaning Plan, as specified.
- D. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- E. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.5 QUALITY ASSURANCE

- A. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com.
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.1 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.2 REPLACEMENT PRODUCTS

- A. Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

2.3 SURFACE TREATMENTS

- A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.
- B. Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less than 25, smoke developed index less than 450, Class A, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.

- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Obtain Owner's approval of proposed temporary locations for large equipment.
- E. Designate a decontamination area and obtain Owner's approval.
- F. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.2 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
 - 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.3 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.

- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- G. Fibrous Glass Material: Use HEPA vacuuming equipment, under constant negative pressure, do not permit to get wet, and do not damage surfaces; replace material damaged by cleaning operations.
- H. Existing Damaged Fibrous Glass Material: Report to Architect all evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture that cannot be remedied by cleaning or resurfacing with an acceptable insulation repair coating.
 - 1. Remove unremediable material and clean underlying surfaces.
 - 2. Replace unremediable material.
- I. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- J. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.4 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.5 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. Notify Owner's testing and inspection agency when cleaned components are ready for inspection.
- F. Owner reserves the right to verify cleanliness using NADCA ACR Surface Comparison Testing or NADCA Vacuum Test.
- G. When directed, re-clean components until they pass.
- H. Contractor shall bear the costs of retesting due to inadequate cleaning.
- I. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.6 ANTI-MICROBIAL TREATMENT

- A. When directed, apply anti-microbial treatment to internal surfaces.
- B. Apply anti-microbial agent after removal of surface deposits and debris.
- C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
- D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

3.7 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.8 WASTE MANAGEMENT

- A. Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.

- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 230130.51

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.2 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
- B. Section 262913 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015, with Errata (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.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for 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.

1.6 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

2.1 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.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 1/2 Horsepower: 208 volts, three phase, 60 Hz.
- B. 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.
- C. 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.
- D. 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.

2.3 APPLICATIONS

PART 3 EXECUTION

3.1 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 230513

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SECTION 230517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 230553 - Identification for HVAC Piping and Equipment: Piping identification.
- C. Section 230716 - HVAC Equipment Insulation.
- D. Section 230719 - HVAC Piping Insulation.

1.3 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.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

- A. See Section 013000 - 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.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Valve Stem Packings: Two for each type and size of valve.

1.5 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.
- 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Manufacturers:
 - 1. American Polywater Corporation; PZVR Watertight Wall Sleeves for Pipes: www.polywater-haufftechnik.com/#sle.
 - 2. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
- B. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. 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.
- D. 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 078400 to prevent the spread of fire, smoke, and gases.

2.2 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.

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. Fire Resistant: 1 hour, UL (DIR) approved.
 - c. High Temperature, up to 400 degrees F.
 - d. 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.

D. Pipe Sleeve Material:

1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.

2. Masonry Structures: Sheet metal or fiber.

E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

PART 3 EXECUTION

3.1 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.

3.2 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. Provide sleeves when penetrating footings, floors, walls, and partitions. 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.

E. 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.

- F. 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.

3.3 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 230517

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SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 Section Includes

- A. Support and attachment components.

1.2 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; 2023.
- 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; 2026.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 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 033000.

1.4 Submittals

- A. See Section 013000 - 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, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- 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.
- 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.

1.5 Quality Assurance

- A. Comply with applicable building code.

PART 2 PRODUCTS

2.1 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 _____. 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. Manufacturers:
 - a. ABB Installation Products: electrification.us.abb.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
2. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
5. 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.
2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.

- b. Piping up to 1 inch: 1/4 inch diameter.
- c. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:

- 1. Manufacturers:
 - a. Buckaroos, Inc: www.buckaroos.com/#sle.
 - b. Snappitz: www.snappitz.com/#sle.
- 2. 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. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
- 3. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Thickness: 60 mil.

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.

F. Pipe Hangers:

1. Split Ring Hangers:

- a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
- b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
- c. Provide hanger rod and nuts of the same type and material for a given pipe run.
- d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

G. 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.
- 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.

H. Anchors and Fasteners:

1. Manufacturers - Mechanical Anchors:

- 2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- 3. Concrete: Use expansion anchors or screw anchors.
- 4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 5. Hollow Masonry: Use toggle bolts.
- 6. Plastic and lead anchors are not permitted.
- 7. Powder-actuated fasteners are not permitted.

PART 3 EXECUTION

3.1 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. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- G. 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.
- H. Secure fasteners according to manufacturer's recommended torque settings.
- I. Remove temporary supports.

END OF SECTION 230529

SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 Section Includes

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

1.2 Related Requirements

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

1.3 Reference Standards

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 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 033000.

1.5 Submittals

- A. See Section 013000 - 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.
 - 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.
- 1.6 Quality Assurance
- A. Comply with applicable building code.
 - B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

- 2.1 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: As indicated on drawings.
 - E. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:

- a. Located in equipment rooms.
- 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.
- 3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
- 4. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.2 Vibration-Isolated Equipment Support Bases

A. Manufacturers:

- 1. Vibration-Isolated Equipment Support Bases:
 - 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-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. 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 033000.

6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

2.3 Vibration Isolators

A. Manufacturers:

1. Vibration Isolators:

- a. ANDRE HVAC International, Inc: www.andrehvac.com/#sle.
- b. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
- c. Mason Industries: www.mason-ind.com/#sle.
- d. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
- e. Vibro-Acoustics: www.vibro-acoustics.com/#sle.

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.

2.4 Acoustical and Vibration Isolators

A. Manufacturers:

1. Acoustical and Vibration Isolators:

- a. HoldRite, a brand of Reliance Worldwide Corporation:
www.holdrite.com/#sle.

B. 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

3.1 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.

3.2 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.

3.3 Field Quality Control

- A. See Section 014000 - 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 230548

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.

1.2 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2025.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Ductwork: Adhesive-backed duct marker or stencil.
- D. Instrumentation: Tags.
- E. Piping: Tags.

- F. Thermostats: Nameplates.
- G. Motorized Dampers: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Marker: www.craftmarkid.com/#sle.
 - 4. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch.
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

2.3 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. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.4 ADHESIVE-BACKED DUCT MARKERS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.

3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

C. Style: Individual Label.

D. Color: Green/White.

2.5 STENCILS

A. Manufacturers:

1. Brady Corporation; _____: www.bradycorp.com/#sle.

2. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.

3. Seton Identification Products, a Tricor Company; _____: www.seton.com/#sle.

B. Stencils: With clean cut symbols and letters of following size:

1. Ductwork and Equipment: 2-1/2 inch high letters.

C. Stencil Paint: As specified in Section 099123, semi-gloss enamel, colors complying with ASME A13.1.

2.6 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. Color: Comply with ASME A13.1.

C. 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.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

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3.2 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. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. 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.
- E. Install ductwork with plastic nameplates. 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.

END OF SECTION 230553

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of refrigerating systems.
- C. Commissioning activities.

1.2 RELATED REQUIREMENTS

- A. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 230800 - Commissioning of HVAC.

1.3 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.
- C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2019, with Errata (2022).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.4 SUBMITTALS

- A. See Section 013000 - 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. Include at least the following in the plan:
 - a. 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.
 - b. 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.

- c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. 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.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in I-P (inch-pound) units only.
 - 6. 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.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. SMACNA (TAB).

- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. 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. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 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.

3.3 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

- A. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- B. Measure air quantities at air inlets and outlets.
- C. 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.
- D. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- E. 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.
- F. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- G. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- H. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

- I. 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.
- J. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 COMMISSIONING

- A. See Sections 019113 - General Commissioning Requirements and 230800 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
 - 1. Air 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.
 - 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.

3.7 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. Air Cooled Condensers:

1. Identification/number.

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.

C. 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.

14. Fan RPM.

D. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Design outside air flow.
6. Actual outside air flow.
7. Return air temperature.
8. Outside air temperature.

E. 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. Fan RPM.

F. 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.

G. Duct Leak Tests:

1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
 - a. Blower.
 - b. Orifice, tube size.
 - c. Orifice size.
 - d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

H. Air Monitoring Stations:

1. Identification/location.
2. System.
3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

I. Flow Measuring Stations:

1. Identification/number.
2. Location.

3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Station calibrated setting.

J. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

END OF SECTION 230593

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SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Jacketing and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- K. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
- L. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.

- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 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.

1.5 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.

PART 2 PRODUCTS

2.1 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.

2.2 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville: www.jm.com/#sle.
 - 3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
 - 4. Manson Insulation, a company of Knauf Insulation; AK Board: www.imanson.com/#sle.
 - 5. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.owenscorning.com/en-us/#sle.
- B. Insulation: ASTM C612; rigid, noncombustible.
 - 1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.

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.

2.3 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:

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: Smooth.

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. Plain Foil Tape:

1. Aluminum foil with pressure-sensitive adhesive on paper release liner.

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2. Finish: Plain foil.

E. UL181 Tape for Rigid and Flexible Ductwork:

1. Comply with UL 181A for rigid ductwork.
2. Comply with UL 181B for flexible ductwork.
3. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
4. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.

2.4 DUCT LINER

A. Manufacturers:

1. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
3. Johns Manville: www.jm.com/#sle.
4. Knauf Insulation; Performance+ Duct Liner: www.knaufinsulation.com/#sle.
5. Owens Corning Corporation; QuietR Rotary Duct Insulation: www.owenscorning.com/en-us/#sle.

B. Note: Choose the liner type - Elastomeric Foam, Glass Fiber, or Phenolic Foam.

C. Elastomeric Foam 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: 180 degrees F.
3. Fungal Resistance: No growth when tested according to ASTM G21.
4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F.
5. Connection: Waterproof vapor barrier adhesive.

D. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.

E. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. 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.
- D. 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.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- F. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 90 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.
 - 6. All new supply and outdoor air ductwork shall be internally insulated.

3.2 SCHEDULES

- A. Supply Ducts: 2" duct liner/internal insulation.

B. Ducts Exposed to Outdoors: 2" duct liner/internal insulatio.

END OF SECTION 230713

SECTION 230716
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment insulation.
- B. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 230553 - Identification for HVAC Piping and Equipment.
- B. Section 232300 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- F. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- G. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- H. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- I. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- L. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - 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.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

PART 2 PRODUCTS

2.1 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.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Owens Corning Corporation; SOFTR Duct Wrap FRK: www.owenscorning.com/en-us/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. Maximum Service Temperature: 1,000 degrees F.
 - 2. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. 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.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- 2.3 GLASS FIBER, RIGID
- A. Manufacturer:
1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
 3. Manson Insulation, a company of Knauf Insulation; AK Board: www.imanson.com/#sle.
 4. Owens Corning Corporation: www.owenscorning.com/en-us/#sle.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 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. Aluminum-Foil Laminate Jacket:
1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Foster - Vapor-Fas: www.fosterproducts.com/#sle.
 2. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- D. 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.

2.4 JACKETING AND ACCESSORIES

A. PVC Plastic:

1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
2. 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.
3. Covering Adhesive Mastic: Compatible with insulation.

B. 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: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.

C. Stainless Steel Jacket: ASTM A666/A666M, Type 304 stainless steel.

1. Thickness: 0.010 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

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.

E. Plain Foil Tape:

1. Aluminum foil with pressure-sensitive adhesive on paper release liner.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 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. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- J. Fiber glass 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.
- K. 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.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- N. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

END OF SECTION 230716

SECTION 230719
HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 232300 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- 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.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 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.

PART 2 PRODUCTS

2.1 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.

2.2 CELLULAR GLASS

- A. Manufacturers:
 - 1. Owens Corning Corporation; FOAMGLAS: www.owenscorning.com/en-us/#sle.
- B. Pipe and Tubing 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.
 - 5. Density: A minimum of 6.12 pcf.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA; AEROFLEX-EP: www.aeroflexusa.com/#sle.
 - 2. Armacell LLC; AP ArmaFlex: www.armacell.us/#sle.
 - 3. K-Flex USA LLC; Insul-Tube: 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.

2.4 JACKETING AND ACCESSORIES

A. PVC Plastic.

1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
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: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. 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.

- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. 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.
 - 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.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- J. 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.

3.2 SCHEDULE

- A. Variable Refrigerant Flow Systems:
 - 1. Condensate Drains from Cooling Coils: Minimum 1/2" flexible elastomeric cellular insulation.
 - 2. Refrigerant Suction: Installed exterior to building: minimum 1" flexible elastomeric cellular insulation; installed interior to building: minimum 1/2" flexible elastomeric cellular insulation.
 - 3. Refrigerant Hot Gas: Installed exterior to building: minimum 1" flexible elastomeric cellular insulation; installed interior to building: minimum 1/2" flexible elastomeric cellular insulation.

END OF SECTION 230719

SECTION 230800
COMMISSIONING OF HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Control system.
 - 2. Major and minor equipment items.
 - 3. Piping systems and equipment.
 - 4. Ductwork and accessories.
 - 5. Terminal units.
 - 6. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.2 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - Application of the Commissioning Process to New HVAC&R Systems; 2025.

1.3 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

- B. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- C. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 - 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
 - 2. Full as-built set of control drawings.
 - 3. Full as-built sequence of operations for each piece of equipment.
 - 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.
 - b. Room number.
 - c. Room name.
 - d. Air handler unit ID.
 - e. Reference drawing number.
 - f. Air terminal unit tag ID.
 - g. Heating and/or cooling valve tag ID.
 - h. Minimum air flow rate.
 - i. Maximum air flow rate.
 - 5. Full print out of all schedules and set points after testing and acceptance of the system.
 - 6. Full as-built print out of software program.
 - 7. Electronic copy on disk of the entire program for this facility.
 - 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
 - 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.

10. Control equipment component submittals, parts lists, etc.
 11. Warranty requirements.
 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
- D. Project Record Documents: See Section 017800 for additional requirements.
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
 2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- E. Draft Training Plan: In addition to requirements specified in Section 017900, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
 2. Control system manufacturer's recommended training.
 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- F. Training Manuals: See Section 017900 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.

3.2 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Provide two-way radios for use during the testing.

D. Valve/Damper Stroke Setup and Check:

1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
7. Closure for Heating Coil Valves - Normally Open:
 - a. Set heating setpoint 20 degrees F above room temperature.
 - b. Observe valve open.
 - c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
 - d. Restore to normal.
 - e. Set heating setpoint to 20 degrees F below room temperature.
 - f. Observe the valve close.
 - g. Restore to normal.
8. Closure for Cooling Coil Valves - Normally Closed:
 - a. Set cooling setpoint 20 degrees F above room temperature.
 - b. Observe the valve close.
 - c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
 - d. Restore to normal.
 - e. Set cooling setpoint to 20 degrees F below room temperature.
 - f. Observe valve open.

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- g. Restore to normal.
 - E. Isolation Valve or System Valve Leak Check: For valves not by coils.
 - 1. With full pressure in the system, command valve closed.
 - 2. Use an ultra-sonic flow meter to detect flow or leakage.
 - F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
- 3.3 TAB COORDINATION
- A. TAB: Testing, adjusting, and balancing of HVAC.
 - B. Coordinate commissioning schedule with TAB schedule.
 - C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
 - D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
 - E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
 - F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.
- 3.4 CONTROL SYSTEM FUNCTIONAL TESTING
- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
 - B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
 - C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
 - D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.

2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
1. Setpoint changing features and functions.
 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
1. That all specified functions and features are set up, debugged and fully operable.
 2. That scheduling features are fully functional and setup, including holidays.
 3. That all graphic screens and value readouts are completed.
 4. Correct date and time setting in central computer.
 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
 7. Power failure and battery backup and power-up restart functions.
 8. Global commands features.
 9. Security and access codes.
 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 11. O&M schedules and alarms.
 12. Occupancy sensors and controls.
 13. Fire alarm interlocks and response.
 14. All control strategies and sequences not tested during controlled equipment testing.

- H. Perform and submit trend logging on the following using the control system, for minimum period of 5 days including one weekend, if the control points are monitored by the control system:
- I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. See Section 017800 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.6 DEMONSTRATION AND TRAINING

- A. See Section 017900 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner's personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
- E. TAB Review: Instruct Owner's personnel for minimum ____ hours, after completion of TAB, on the following:
 - 1. Review final TAB report, explaining the layout and meanings of each data type.
 - 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
5. Other salient information that may be useful for facility operations, relative to TAB.

F. HVAC Control System Training: Perform training in at least three phases:

1. Phase 1 - Basic Control System: Provide minimum of ____ hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - a. This training may be held on-site or at the manufacturer's facility.
 - b. If held off-site, the training may occur prior to final completion of the system installation.
 - c. For off-site training, Contractor shall pay expenses of up to two attendees.
2. Phase 2 - Integrating with HVAC Systems: Provide minimum of ____ hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
 - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.

- 3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 2 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.
- G. Provide the services of manufacturer representatives to assist instructors where necessary.
- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION 230800

SECTION 230923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System description.
- B. Operator interface.
- C. Controllers.
- D. Power supplies and line filtering.
- E. System software.
- F. Controller software.
- G. HVAC control programs.

1.2 RELATED REQUIREMENTS

- A. Section 230913 - Instrumentation and Control Devices for HVAC.
- B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2025).
- B. ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems; 2019, with Addendum (2024).
- C. 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 .
- D. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks; 2024.
- E. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4; 2005.
- F. LonMark SCPT List - LonMark SCPT Master List; Version 15; 2014.
- G. LonMark SNVT List - LonMark SNVT Master List; Version 15; 2014.

- H. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2022h, with Editorial Revision.
- I. Modbus (PS) - The Modbus Organization Communications Protocol.; Latest Update.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 - 3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 4. Indicate description and sequence of operation of operating, user, and application software.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.

2. Include submittals data in final "Record Documents" form.
 - I. Operation and Maintenance Data:
 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - J. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
 - K. Maintenance Materials:
 1. See Section 016000 - Product Requirements, for additional provisions.
- 1.6 QUALITY ASSURANCE
- A. Perform work in accordance with NFPA 70.
 - B. Designer Qualifications: Perform design of system using manufacturer's software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
 - C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
 - D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- 1.7 WARRANTY
- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
 - B. Correct defective Work within a five year period after Substantial Completion.
 - C. Provide five year manufacturer's warranty for field programmable micro-processor based units.
- 1.8 PROTECTION OF SOFTWARE RIGHTS
- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
 1. Limiting use of software to equipment provided under these specifications.

2. Limiting copying.
3. Preserving confidentiality.
4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Honeywell International, Inc; _____: www.honeywell.com/#sle.
- B. Substitutions: See Section 016000 - Product Requirements.

2.2 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 230913.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.
- G. The Free Library of Philadelphia requires the Building Automation System (BAS) to be non-proprietary. The basis of design BAS shall be Tridium Niagara framework, or an approved equal.

2.3 OPERATOR INTERFACE

- A. PC Based Work Station:
 1. Resides on high speed network with building controllers.
 2. Connected to server for full access to all system information.

B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.

C. Hardware:

1. Desktop:

a. Computer(s) and display(s) to be provided by DDC controls manufacturer.

b. Quantity: Provide allowance for 1 computer(s).

c. Location(s): As directed by the Owner.

d. Network Connection:

1) Ethernet interface card.

e. System Printer:

1) Printer(s) to be provided by DDC controls manufacturer.

2) Quantity: Provide allowance for 1 computers.

3) Locations(s): As directed by the Owner.

2. Laptop:

a. Laptop(s) to be provided by DDC controls manufacturer.

b. Quantity: Provide allowance for 1 computer(s).

c. Drives: _____.

d. Display: _____.

e. Network Connection:

1) Ethernet interface card.

f. System Printer:

1) Printer(s) to be provided by DDC controls manufacturer.

2) Quantity: 1.

2.4 CONTROLLERS

A. Building Controllers:

1. General:

- a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
2. Communication:
- a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. External Input-Output (I-O) Data Bus:
- a. Variable frequency drives (VFD's).
 - b. Universal I-O module (configurable).
 - c. Access control module for single door.
 - d. Multiple Input Output (I-O) Module:
 - 1) IAQ: Temperature, humidity, and CO2.
 - 2) Audio: Microphone, tone generator, and speaker.
 - 3) Input and output terminals to monitor or control local devices.

- 4) Occupancy: Light and thermal sensing with multi-colored LED feedback.
- 4. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 5. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 7. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
- B. Custom Application Controller:
 - 1. General:
 - a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - b. Share data between networked, microprocessor based controllers.
 - c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - d. Utilize real-time clock for scheduling.

- e. Continuously check processor status and memory circuits for abnormal operation.
 - f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - g. Communication with other network devices to be based on assigned protocol.
2. Communication:
- a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
- a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
- a. Diagnostic LED's for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
- a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

C. Application Specific Controllers:

1. Manufacturers:

- a. Honeywell.

2. General:

- a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
- b. Customized for operation within the confines of equipment served.
- c. Communication with other network devices to be based on assigned protocol.

3. Communication:

- a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
- b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.

4. Anticipated Environmental Ambient Conditions:

- a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
- b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.

5. Provisions for Serviceability:

- a. Diagnostic LEDs for power, communication, and processor.
- b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

7. Power and Noise Immunity:

- a. Maintain operation at 90 to 110 percent of nominal voltage rating.

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- b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- 8. Smart Thermostat:
 - a. Manufacturers:
 - 1) Mitsubishi Electric Trane US.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - b. Alphanumeric color display with button interface, white faceplate or fascia, multi-language support, surface or wall-mount over single gang box.
 - c. Sensor: 1,000 ohm Platinum RTD within insulated thermoplastic enclosure.
 - d. Temperature Control: Heating or cooling, On/Off control.
 - e. Humidity Control: Humidification.
 - f. Fan Control: Three speed, On/Off.
 - g. Combined Measurement Requirement:
 - 1) Humidity: 0 to 100 percent (non-condensing).
 - 2) CO2 (Carbon Dioxide): 0 to 2,000 ppm.
 - h. Primary Interface: ASHRAE Std 135 BACnet MS/TP communications.
 - i. Certification: BACnet Testing Laboratory (BTL) certified device listed under the BACnet Smart Sensor (B-SS) device profile in compliance with ASHRAE Std 135.

D. Input/Output Interface:

- 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
- 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.

3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:

- c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- 9. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
 - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.5 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.

- c. Transverse mode noise attenuation of 65 dB or greater.
- d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.6 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 60 stations or nodes.
- C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- D. LAN Data Speed: Minimum 19.2 Kb.
- E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
- F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.7 SYSTEM SOFTWARE

- A. Operating System:
 - 1. Concurrent, multi-tasking capability.
 - a. Common Software Applications Supported: Microsoft Excel.
 - b. Acceptable Operating Systems: _____.
 - 2. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:

- a) Analog and binary values.
 - b) Dynamic text.
 - c) Static text.
 - d) Animation files.
 - 3. Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics in PCX formats.
 - b. HTML graphics to support web browser compatible formats.
 - c. Capture or convert graphics from AutoCAD.
 - 4. Standard HVAC Graphics Library:
 - a. HVAC Equipment:
 - 1) Air Handlers.
 - 2) Terminal HVAC Units.
 - 3) Fan Coil Units.
 - b. Ancillary Equipment:
- B. Workstation System Applications:
- 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on hard disk.
 - b. Automatic update occurs upon change in any system panel.
 - c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. All system security data stored in encrypted format.
6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Modems.
 - 4) Network connections.
 - 5) Building management panels.
 - 6) Controllers.
 - b. Device failure is annunciated to the operator.
7. Alarm Processing:

- a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - b. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
8. Alarm Messages:
- a. Descriptor: English language.
 - b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
- a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
10. Custom Trend Logs:
- a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.

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- 2) Archivable on hard disk.
- 3) Retrievable for use in reports, spreadsheets and standard database programs.
- 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
- 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.

11. Alarm and Event Log:

- a. View all system alarms and change of states from any system location.
- b. Events listed chronologically.
- c. Operator with proper security acknowledges and clears alarms.
- d. Alarms not cleared by operator are archived to the workstation hard disk.

12. Object, Property Status and Control:

- a. Provide a method to view, edit if applicable, the status of any object and property in the system.
- b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.

13. Reports and Logs:

- a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
- b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
- c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
- d. Set to be printed on operator command or specific time(s).

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14. Reports:

a. Standard:

- 1) Objects with current values.
- 2) Current alarms not locked out.
- 3) Disabled and overridden objects, points and SNVTs.
- 4) Objects in manual or automatic alarm lockout.
- 5) Objects in alarm lockout currently in alarm.
- 6) Logs:
 - a) Alarm History.
 - b) System messages.
 - c) System events.
 - d) Trends.

b. Custom:

- 1) Daily.
- 2) Weekly.
- 3) Monthly.
- 4) Annual.
- 5) Time and date stamped.
- 6) Title.
- 7) Facility name.

c. Tenant Override:

- 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
- 2) Annual report showing override usage on a monthly basis.

d. Electrical and Weather:

- 1) Electrical Meter(s):

- a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
 - b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
 - 2) Fuel Meter(s):
 - a) Monthly showing daily natural gas consumption for each meter.
 - b) Annual summary showing monthly consumption for each meter.
 - 3) Weather:
 - a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- C. Workstation Applications Editors:
 - 1. Provide editing software for each system application at PC workstation.
 - 2. Downloaded application is executed at controller panel.
 - 3. Full screen editor for each application allows operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
 - 4. Scheduling:
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be scheduled and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
 - 5. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:

- 1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
- 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
- 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
- 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
- 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
- 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
- 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
- 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.8 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 1. User access secured via user passwords and user names.
 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 3. User Log On/Log Off attempts are recorded.

4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
1. Binary object is set to alarm based on the operator specified state.
 2. Analog object to have high/low alarm limits.
 3. All alarming is capable of being automatically and manually disabled.
 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - c. Reporting Options:
 - 1) Start programs.
 - 2) Print.
 - 3) Logged.
 - 4) Custom messaging.
 - 5) Graphical displays.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation on sheet M4.0.
- H. PID Control Characteristics:
1. Direct or reverse action.

2. Anti-windup.
 3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
 4. User selectable controlled variable, set-point, and PED gains.
- I. Staggered Start Application:
1. Prevents all controlled equipment from simultaneously restarting after power outage.
 2. Order of equipment startup is user selectable.
- J. Energy Calculations:
1. Accumulated instantaneous power or flow rates are converted to energy use data.
 2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
 3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- K. Anti-Short Cycling:
1. All binary output objects protected from short-cycling.
 2. Allows minimum on-time and off-time to be selected.
- L. On-Off Control with Differential:
1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- M. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
 2. Provides operator with capability to assign high run-time alarm.
- 2.9 HVAC CONTROL PROGRAMS
- A. General:

1. Support Inch-pounds units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:

1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:
 - a. Define term schedule.
 - b. Add/delete fan status point.
 - c. Add/delete outside air temperature point.
 - d. Define heating/cooling parameters.
 - e. Request optimal run time control summary.
 - f. Request optimal run time mass temperature summary.
 - g. Request HVAC point summary.
 - h. Request HVAC saving profile summary.
7. Control Summary:
 - a. HVAC Control system begin/end status.
 - b. Optimal run time lock/unlock control status.
 - c. Heating/cooling mode status.
 - d. Optimal run time schedule.
 - e. Start/Stop times.

- f. Occupancy and vacancy times.
 - g. Optimal run time system heating/cooling mode parameters.
- 8. HVAC point summary:
 - a. Control system identifier and status.
 - b. Point ID and status.
 - c. Outside air temperature point ID and status.
 - d. Mass temperature point ID and point.
 - e. Calculated optimal start and stop times.
 - f. Period start.
- C. Supply Air Reset:
 - 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
 - 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
 - a. Raising cooling temperatures to highest possible value.
 - b. Reducing heating temperatures to lowest possible level.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 230993.

- C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.
- C. Provide basic operator training for 4 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

3.5 MAINTENANCE

- A. Provide service and maintenance of energy management and control systems for two years from Date of Substantial Completion.
- B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
- C. Provide complete service of systems, including call backs. Make minimum of 2 complete normal inspections of approximately 2 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

END OF SECTION 230923

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SECTION 230934
VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC

PART 1 GENERAL

1.1 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.

1.2 RELATED REQUIREMENTS

- A. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.
- B. Section 230548 - Vibration and Seismic Controls for HVAC.
- C. Section 230553 - Identification for HVAC Piping and Equipment: Identification products and requirements.
- D. Section 260526 - Grounding and Bonding for Electrical Systems.

1.3 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 - Adjustable Speed Drives; 2020 (Reapproved 2025).
- 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 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. 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.

1.4 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.

1.5 SUBMITTALS

- A. See Section 013000 - 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.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain copy of each referenced document that prescribes execution requirements at project site.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

- D. Installer Qualifications: Company with minimum three years documented experience with variable-frequency motor control systems of similar size, type, and complexity; manufacturer's authorized installer.

1.7 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.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB: www.abb.com/#sle.
- B. Substitutions: See Section 016000 - Product Requirements.
- C. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.2 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. 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.
- D. 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.
- E. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- F. 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.
- G. Power Conversion System: Microprocessor-based, pulse width modulation type.
- H. 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.
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. Features:
 - a. Password-protected security access.
 - b. Event log.
- I. 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.
- J. 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.
- K. 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.
- L. Short Circuit Current Rating:
 1. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
- M. Conductor Terminations: Suitable for use with conductors to be installed.
- N. 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:
 3. Finish: Manufacturer's standard unless otherwise indicated.
 4. Cooling: Forced air or natural convection as determined by manufacturer.

2.3 OVERCURRENT PROTECTIVE DEVICES

PART 3 EXECUTION

3.1 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.

3.2 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 230529.
- F. Install controllers plumb and level.

- G. Provide grounding and bonding in accordance with Section 260526.
- 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.
- 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.

3.3 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. Correct deficiencies and replace damaged or defective controllers or associated components.

3.4 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.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.

END OF SECTION 230934

SECTION 232113
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Equipment drains and overflows.
- C. Pipe hangers and supports.
- D. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 RELATED REQUIREMENTS

- A. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.3 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 B31.9 - Building Services Piping; 2025.
- D. ASTM B32 - Standard Specification for Solder Metal; 2020.
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- F. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- G. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- H. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2024).
- I. AWWA C606 - Grooved and Shouldered Joints; 2022.
- J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.
 2. Indicate valve data and ratings.
 - C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
 - D. Project Record Documents: Record actual locations of valves.
 - E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 3. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
 - b. Use rigid joints unless otherwise indicated.
 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

- D. Valves: Provide valves where indicated:

2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

2.3 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.4 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches and Less:
 - 1. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Mechanical Couplings: Comply with ASTM F1476.
 - 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 - 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Section 232500 for additional requirements.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and to avoid interference with use of space.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange to drain at low points.
- F. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 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 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Provide copper plated hangers and supports for copper piping.
 - 6. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

END OF SECTION 232113

SECTION 232300
REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.
- M. Flexible connections.
- N. Engineered wall seals and insulation protection.
- O. Exterior penetration accessories.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 230716 - HVAC Equipment Insulation.
- C. Section 230719 - HVAC Piping Insulation.
- D. Section 230993 - Sequence of Operations for HVAC Controls.
- E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; 2005.
- B. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers; 2009.
- C. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers; 2009.
- D. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants; 2014.
- E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2025).
- F. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).
- G. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .
- H. 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.
- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- J. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2024.
- K. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- L. ASME B31.9 - Building Services Piping; 2025.
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- Q. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- R. 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; 2019.

- S. 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).
 - T. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
 - U. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
 - V. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
 - W. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
 - X. IAPMO (UMC) - 2024 Uniform Mechanical Code; 2024.
 - Y. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - Z. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
 - AA. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
 - BB. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.
- 1.4 SUBMITTALS
- A. See Section 013000 - 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. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
 - D. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
 - E. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - F. Test Reports: Indicate results of leak test, acid test.
 - G. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

- H. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- I. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Filter-Dryer Cartridges: One of each type and size.
 - 3. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

1.6 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

2.1 SYSTEM DESCRIPTION

- A. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- B. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- C. Valves:
 - 1. Use service valves on suction and discharge of compressors.

2. Use gauge taps at compressor inlet and outlet.
 3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
 4. Use check valves on compressor discharge.
 5. Use check valves on condenser liquid lines on multiple condenser systems.
- D. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- E. Strainers:
1. Use line size strainer upstream of each automatic valve.
 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 3. On steel piping systems, use strainer in suction line.
 4. Use shut-off valve on each side of strainer.
- F. Filter-Driers:
1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

2.2 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. Welders Certification: In accordance with ASME BPVC-IX.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.3 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 1. Fittings: ASME B16.22 wrought copper.
 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
 3. Mechanical Press Fittings: UL 207 listed, ICC (IMC) and IAPMO (UMC) approved, with HNBR seals.
 - a. Manufacturers:

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- 1) Mueller Streamline, Co; ACR: www.muellerstreamline.com/#sle.
 - 2) NIBCO INC; PressACR: www.nibco.com/#sle.
- B. Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
1. Fittings: ASME B16.26 cast copper.
 2. Joints: Flared.
 3. Mechanical Press Sealed Fittings: UL 207 listed, ICC (IMC) and IAPMO (UMC) approved, with HNBR seals.
 - a. Manufacturers:
 - 1) FNW; Copper Press: www.fnw.com/#sle.
 - 2) Mueller Streamline, Co; ACR: www.muellerstreamline.com/#sle.
 - 3) NIBCO INC; PressACR: www.nibco.com/#sle.
- C. Pipe Supports and Anchors:
1. Provide hangers and supports that comply 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 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Vertical Support: Steel riser clamp.
 7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 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.

2.4 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.
- B. Refrigerant: R-32 as defined in ASHRAE Std 34.

2.5 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:
 - 1. Henry Technologies: www.henrytech.com/#sle.
 - 2. Mueller Refrigeration: www.muellerrefrigeration.com/#sle.
 - 3. Parker Hannifin - Sporlan Division; See-All: www.parker.com/#sle.
- B. 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.

2.6 VALVES

- A. Manufacturers:
 - 1. Hansen Technologies Corporation: www.hantech.com/#sle.
 - 2. Henry Technologies: www.henrytech.com/#sle.
 - 3. Flomatic Valves: www.flomatic.com/#sle.
 - 4. Mueller Refrigeration: www.muellerrefrigeration.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. 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.
- C. 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.

D. 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.

E. 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.

2.7 STRAINERS

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.
2. Mueller Refrigeration: www.muellerrefrigeration.com/#sle.
3. Parker Hannifin - Sporlan Division: www.parker.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. 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.

2.8 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.

B. Straight Through Type:

1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.9 PRESSURE REGULATORS

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.

2. Parker Hannifin: www.parker.com/#sle.

- B. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.10 PRESSURE RELIEF VALVES

A. Manufacturers:

1. Hansen Technologies Corporation: www.hantech.com/#sle.

2. Henry Technologies: www.henrytech.com/#sle.

3. Mueller Refrigeration: www.muellerrefrigeration.com/#sle.

4. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com/#sle.

- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.11 FILTER-DRIERS

A. Manufacturers:

1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.

2. Mueller Refrigeration: www.muellerrefrigeration.com/#sle.

3. Parker Hannifin - Sporlan Division; Catch-All: www.parker.com/#sle.

B. Performance:

1. Flow Capacity - Liquid Line: As indicated in schedule, 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.

- C. 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.

D. Construction: UL listed.

1. Connections: As specified for applicable pipe type.

2.12 SOLENOID VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.

B. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.

C. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.13 EXPANSION VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com/#sle.

2. Parker Hannifin - Sporlan Division: www.parker.com/#sle.

B. Angle or Straight Through Type: AHRI 760 (I-P); design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.14 ELECTRONIC EXPANSION VALVES

A. Manufacturers:

1. Flomatic Valves: www.flomatic.com/#sle.

2. Parker Hannifin - Sporlan Division: www.parker.com/#sle.

B. Valve:

1. Brass body with flared or soldered connection, needle valve with floating needle and machined seat, stepper motor drive.

C. Evaporation Control System:

1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
 - D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.
- 2.15 RECEIVERS
- A. Manufacturers:
 1. Henry Technologies: www.henrytech.com/#sle.
 2. Parker Hannifin: www.parker.com/#sle.
 3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com/#sle.
 - B. Internal Diameter 6 inch and Smaller:
 1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
 - C. Internal Diameter Over 6 inch:
 1. AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.
- 2.16 FLEXIBLE CONNECTORS
- A. Manufacturers:
 1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk/#sle.
 2. Flexicraft Industries: www.flexicraft.com/#sle.
 3. Penflex: www.penflex.com/#sle.
 - B. 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.
- 2.17 ENGINEERED WALL SEALS AND INSULATION PROTECTION
- A. Manufacturers:
 1. Airex Manufacturing, Inc: www.airexmfg.com/#sle.

- B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.
 - 1. Pipe Penetration Wall Seal: Airex Titan Outlet.
 - 2. Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
 - 3. Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.
- C. 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.
- D. 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.
 - 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 25/450: Comply with ASTM E84.

2.18 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
 - 1. Products:

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

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- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 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. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 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.
- F. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Flood piping system with nitrogen when brazing.
- I. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- J. Insulate piping and equipment.
- K. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

- L. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- M. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- N. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- O. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- P. Fully charge completed system with refrigerant after testing.
- Q. Provide electrical connection to solenoid valves. See Section 260583.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - 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.

END OF SECTION 232300

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.
- C. Air plenums and casings.

1.2 RELATED REQUIREMENTS

- A. Section 230130.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- B. Section 230713 - Duct Insulation: External insulation and duct liner.
- C. Section 233300 - Air Duct Accessories.
- D. Section 233319 - Duct Silencers.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- D. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- E. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- F. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- G. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

- I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- K. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
- L. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - 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.
- D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meets or exceed specified requirements.
- E. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).
- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

1.6 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

PART 2 PRODUCTS

2.1 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. Provide metal duct unless otherwise indicated.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
 - 1. Round: Plus or minus 2 in-wc of galvanized steel.

2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
 - a. Supply Air: 1/2 in-wc pressure class, galvanized steel.
 - b. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
 - c. Return and Relief Air: 1/2 in-wc pressure class, galvanized steel.
 - d. General Exhaust Air: 1/2 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.
 3. Low Pressure Service: From 2 in-wc to 3 in-wc:
 - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
 - b. Leakage:
 - 1) Rectangular: Class 12 or 12 cfm/100 sq ft.
 - 2) Round: Class 6 or 6 cfm/100 sq ft.
- F. Duct Fabrication Requirements:
1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 3. 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.
 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
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.

2.2 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
2. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

B. Metal Duct Coating Requirements:

1. Antimicrobial Coating: Factory- or field-applied in accordance with manufacturer's instructions.
 - a. Manufacturers:
 - 1) MKT Metal Manufacturing: www.mktduct.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.

C. Rectangular Metal Duct:

1. Rectangular Single Wall: Rectangular, longitudinal lock seam duct with galvanized steel wall.
2. Rectangular Double Wall Insulated: Rectangular, longitudinal lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
 - a. Insulation:
 - 1) Thickness: 2 inch.

D. Flat-Oval Metal Ducts:

1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
 - a. Fittings: Manufacture at least two gauges heavier metal than the duct.

- b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 - c. Manufacturers:
 - 1) EHG, a DMI Company: www.ehgduct.com/#sle.
 - 2) Linx Industries, Inc a DMI Company: www.li-hvac.com/#sle.
 - 3) Substitutions: See Section 016000 - Product Requirements.
 - 2. Flat-Oval Double Wall Insulated Duct: Machine made from round spiral lock seam duct.
 - a. Fittings: Manufacture with solid inner wall.
 - b. Inner Wall: Perforated galvanized steel.
 - c. Insulation:
 - 1) Thickness: 2 inch fiberglass.
- E. Round Metal Ducts:
- 1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
 - a. Manufacturers:
 - 1) EHG, a DMI Company; _____: www.ehgduct.com/#sle.
 - 2) Elgen Manufacturing Company, Inc; Snap Lock Pipes and Fittings: www.elgenmfg.com/#sle.
 - 3) Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
 - 2. 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.
 - b. Manufacturers:
 - 1) MKT Metal Manufacturing; Weatherguard: www.mktduct.com/#sle.

- 2) Substitutions: See Section 016000 - Product Requirements.
 3. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- F. Round Spiral Duct:
1. Round spiral lock seam duct with galvanized steel outer wall.
 2. Manufacturers:
 - a. EHG, a DMI Company: www.ehgduct.com/#sle.
 - b. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - c. GSI, a DMI Company: www.greenseamind.com/#sle.
 - d. Linx Industries, Inc, a DMI Company: www.li-hvac.com/#sle.
 - e. MKT Metal Manufacturing: www.mktduct.com/#sle.
- G. 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).
 - a. Manufacturers:
 - 1) Carlisle HVAC Products; Nexus Flange Connectors with Sealant Pocket: 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) Substitutions: See Section 016000 - Product Requirements.
 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. VOC Content: Not more than 250 g/L, excluding water.

- c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- d. For Use with Flexible Ducts: UL labeled.
- e. Manufacturers:
 - 1) Carlisle HVAC Products; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant: www.carlislehvac.com/#sle.
 - 2) Design Polymerics; DP 1010 Water Based Smooth Duct Sealant, Premium Quality: www.designpoly.com/#sle.
 - 3) Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 4) Elgen Manufacturing Company, Inc; Duct Sealer: www.elgenmfg.com/#sle.
 - 5) H.B. Fuller Construction Products, Inc: www.fosterproducts.com/#sle.
- 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. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
 - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 - f. Other Types: As required.

2.3 FLEXIBLE DUCTS

- A. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.

1. Insulation: R6 insulation with polyethylene vapor barrier film.
2. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
3. Maximum Velocity: 5500 fpm.
4. Temperature Range: Minus 20 degrees F to 250 degrees F.
5. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 1:
www.flexmasterusa.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

B. Flexible Air Ducts:

1. UL 181, Class 1, polyethylene film supported by helically wound spring steel wire.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
3. Pressure Rating: From 10 in-wc to 5 in-wc negative.
4. Maximum Velocity: 5,500 fpm.
5. Temperature Range: Minus 20 to 250 degrees F.
6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc; Type 1:
www.flexmasterusa.com/#sle.

2.4 AIR PLENUMS AND CASINGS

- A. Fabricate in accordance with SMACNA (DCS) for indicated operating pressures indicated.
- B. Minimum Fabrication Requirements:
 1. Fabricate acoustic plenum or casing with reinforcing turned inward.
 2. Provide 16-gauge, 0.059-inch sheet steel back facing and 22-gauge, 0.029-inch perforated sheet steel front facing with 3/32 inch diameter holes on 5/32 inch centers.
 3. Construct panels 3 inches thick, packed with 4.5 pcf minimum glass fiber insulation media, on inverted channel of 16-gauge, 0.059-inch sheet steel.

4. Mount floor-mounted plenum or casings on 4-inch high concrete curbs. At floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18-gauge, 0.052-inch expanded metal mesh supported at 12-inch centers, turned up 12 inches at sides with sheet metal shields.

C. Access Doors:

1. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
2. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
3. Provide clear wire glass observation ports, minimum 6 by 6 inch size.

PART 3 EXECUTION

3.1 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. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Flexible Ducts: Connect to metal ducts with mechanical fastener.
- F. PVC Coated Metal Ductwork: Tape with PVC tape.
- G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- I. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.
- J. Use double nuts and lock washers on threaded rod supports.
- K. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- L. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

- M. Set plenum doors at 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- N. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- O. 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.

3.2 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean thoroughly each duct system. See Section 230130.51.
- C. Clean duct system by forcing air at high velocity through duct to remove accumulated dust. Clean half the system at a time to obtain sufficient air. Protect equipment that could be harmed by excessive dirt with temporary filters or bypass during cleaning.

END OF SECTION 233100

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connectors.
- G. Volume control dampers.
- H. Air measuring control dampers.
- I. Miscellaneous Products:
 - 1. Airflow meters, fixed-resistance type.

1.2 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 233100 - HVAC Ducts and Casings.
- C. Section 233600 - Air Terminal Units: Pressure regulating damper assemblies.
- D. Section 253513 - Integrated Automation Actuators and Operators: Damper operators.
- E. Section 253523 - Integrated Automation Control Dampers: Product furnishing.

1.3 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- F. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- I. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- L. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - 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.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- E. Project Record Drawings: Record actual locations of access doors and test holes.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Fusible Links: One of each type and size.

1.5 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. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 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.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.2 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. Pottorff: www.pottorff.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle.
- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- C. 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.

2.3 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. Nailor Industries, Inc: www.nailor.com/#sle.
4. Ruskin Company: www.ruskin.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.4 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.

2.5 FIRE DAMPERS

A. Manufacturers:

1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
2. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
3. Nailor Industries, Inc: www.nailor.com/#sle.
4. Pottorff: www.pottorff.com/#sle.
5. Ruskin Company: www.ruskin.com/#sle.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.

E. Multiple Blade Dampers: 16-gauge, 0.0598-inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by

1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

- F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.6 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:

1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/#sle.
2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
 - a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

2.7 VOLUME CONTROL DAMPERS

A. Products for Automatic Controls: See Section 253523.

B. Manufacturers:

1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
2. Nailor Industries, Inc: www.nailor.com/#sle.
3. Pottorff: www.pottorff.com/#sle.
4. Ruskin Company: www.ruskin.com/#sle.

C. Fabricate in accordance with SMACNA (DCS) and as indicated.

D. Splitter Dampers:

1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

E. Single Blade Dampers:

1. Fabricate for duct sizes up to 6 by 30 inch.
2. Blade: 24 gauge, 0.0239 inch, minimum.

- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

2.8 AIR MEASURING CONTROL DAMPERS

A. Manufacturers

1. Greenheck Fan Corporation: www.greenheck.com/#sle.
2. Ruskin Company: www.ruskin.com/#sle.

B. Factory-Mounted Assembly Requirements:

1. Damper Unit or Multi-Unit:
 - a. Construction: Flanged-to-duct frame made of extruded aluminum with V or 3V blades for low to medium pressure applications, zinc-plated steel hardware, frame-mounted shaft bearings, frame-assembly sleeve, and silicone seals at frame and blade ends.
 - b. Control: Opposed blade modulation by damper actuator(s) from air measuring sensor transmitter-controller unit.
2. Air Measuring Sensor Transmitter-Controller:
 - a. Type: Externally-powered, multi-point, multi-probe airflow and temperature monitoring using sensor array of thermal dispersion type wired to externally-mounted transmitter-controller.
 - b. Air Velocity Monitoring Range: 0 to 2000 fpm, bidirectional. Factory configure monitor calculate airflow and differential pressure from listed range.
 - c. Temperature Monitoring Range: 32 to 104 degrees F.
 - d. Transmitter: Five percent accuracy, adjustable zero and span, 10 to 1 turndown, 0.1 percent of calibrated span linearity, 30 to 50 millisecond response time, minimum overpressure of 150 percent over highest range value, alphanumeric indicating display, wired or wireless connectivity for configuration, and terminal strip within enclosed electronic components.

- e. Controller: Configure to control hardware-linked damper actuator(s) based on locally typed or software-defined setpoint. Access for user to do local or remote proportional, integrative, and derivative control-loop tuning.
 - f. Hardwired External Damper Actuator Output: Two-wire, 4 to 20 mA.
 - g. BTU Metering: Provide temperature sensor for field mounting upstream or downstream of heating or cooling source.
 - 3. Damper Actuator(s), Field-Installed:
 - a. See Section 253513 for electronic type with manual override.
 - b. Provide flexible conduit and interface cables into transmitter-controller to receive matching output signal and matching power feed.
 - C. Service Temperature Range: Minus 20 to 160 degrees F.
 - D. Enclosure Rating for Transmitter-Controller and Damper Actuator(s):
 - 1. General: UL 50 or UL 50E listed for use in non-hazardous locations.
- 2.9 MISCELLANEOUS PRODUCTS
- A. Airflow Meters, Fixed-Resistance Type:
 - 1. Manufacturers:
 - a. Air Monitor, a Brand of Onicon, Inc: www.onicon.com/#sle.
 - b. KMC Controls; Conquest Airflow Measurement System: www.kmccontrols.com/#sle.
 - 2. Sensor Type: Provide duct-inserted probe, duct-inserted pitot-tube assembly, and wall-mounted assembly for outside air with built-in transmitter.
 - 3. Flow Range: Equivalent velocity pressure required to match scheduled flow range with 100-to-1 signal turndown ratio.
 - 4. Linearity: 0.1 percent of calibrated span.
 - 5. Minimum Overpressure: 150 percent over highest range value.
 - 6. Output: Two-wire, 4 to 20 mA.
 - 7. Access Box: NEMA EN 10250, Type 1 with hinged cover housing and cable access ports.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. 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 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- J. Use splitter dampers only where indicated.

END OF SECTION 233300

SECTION 237223
PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Energy recovery units.
- B. Casing.
- C. Fans.
- D. Filters.
- E. Dampers.
- F. Vibration isolation.
- G. Power and controls.
- H. Accessories.
- I. Service accessories.

1.2 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- C. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.
- D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.
- E. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- J. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- K. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's installation instruction, product data, and engineering calculations.
- C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.
- D. Closeout Submittals: Submit manufacturer's operation and maintenance instructions.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Spare Parts: One of each kind of filter.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Firm regularly engaged in manufacturing energy recovery units.
 - 2. Products in satisfactory use in similar service for not less than five years.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in manufacturer's unopened packaging.
- B. Store products to be installed indoors in dry, heated area.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

- B. Warranty ventilator to be free from defects in material and workmanship and of all parts for period of 1-1/2 years from date of Substantial Completion.
- C. Warranty energy recovery wheel to be free from defects in material and workmanship for 3 years under circumstances of normal use.
- D. Warranty motor to be free from defects in material and workmanship for 7 years under circumstances of normal use.
- E. Warranty dessicant core to be free from defects in material and workmanship for 5 years under circumstances of normal use.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Energy Recovery Ventilators:
 - 1. RenewAire: www.renewaire.com/#sle.
 - 2. Greenheck.

2.2 ENERGY RECOVERY UNITS

- A. Energy Recovery Units: Provide stationary core air-to-air exchanger; prefabricated packaged system designed by manufacturer.
 - 1. Provide unit with a AHRI 1060 (I-P) compliant air-to-air exchanger.
 - 2. Access: Hinged and/or screwed access panels on front.
 - 3. Lifting holes at the unit base.
 - 4. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
 - 5. Permanent name plate listing manufacturer mounted inside door near electrical panel.
- B. Inline Supply Fan:
 - 1. Construction: Galvanized steel and insulated housing.
 - 2. Plastic components to comply with UL 94.
 - 3. Filters:
 - a. Mounted in open end rack for easy removal.
 - b. Washable 2 inch aluminum mesh.

- c. MERV 13 filter.
- 4. Provide temperature and humidity sensor.
- 5. Provide mounting brackets, equipment supports, and access doors.
- 6. Electrical Requirements:
 - a. Single-point power connection, hardwired.
 - b. Equipment wiring to comply with requirements of NFPA 70.
- C. Accessories:
 - 1. Make-up Air Damper: Normally closed damper to replace exhausted air.
 - a. Duct Construction: Galvanized steel.
 - b. Duct Connections: 6 inch diameter.
 - c. Provide with pressure switch and electric actuator.
 - d. Electrical Requirements:
 - 1) 24-volt transformer.
 - 2) Equipment wiring to comply with requirements of NFPA 70.

2.3 CASING

- A. Wall, Floor, and Roof Panels:
 - 1. Panels: Removable.
 - 2. Construction: 1 inch thick, double wall box construction, with formed edges of exterior wall overlapping formed edges of interior wall.
 - 3. Aluminum is standard. Factory-painted aluminized steel is an economic alternative when the higher corrosion resistance of aluminum is not required.
 - 4. Exterior Wall: Galvanized steel sheet.
 - a. 20 gauge, 0.0359 inch galvanized steel.
 - b. 0.040 inches thick aluminum.
 - 5. Interior Wall: Galvanized sheet metal.
 - a. 20 gauge, 0.0359 inch aluminized steel.
 - b. 22 gauge, 0.0299 inch galvanized sheet metal.

6. Insulation:
 - a. 1/2 inch insulated fiberglass.
 - b. Panel Cores: Mineral wool board.
 - c. Include antimicrobial protection.
 - d. Mold Resistance: "Pass" when tested according to ASTM C1338.
 - e. Fungal Resistance: No growth when tested according to ASTM G21.
 - f. Bacteria Resistance: No growth when tested according to UL 181.
 - g. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
 - h. Smoke Developed Index (SDI): 50, maximum, when tested in accordance with ASTM E84 or UL 723.
7. Roof Panel: Weatherproof.
8. Coating: Polyurethane enamel.
- B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.
- C. Doors:
 1. Construct doors of same construction and thickness as wall panels.
 2. Height: 80 inches.

2.4 FANS

- A. Provide separate fans for exhaust and supply blowers.
- B. Fans:
 1. Individually driven with a dedicated motor.
 2. Backward inclined.
 3. Single width, single inlet.
 4. Class 1 aluminum wheels.
 5. AMCA-rated.
 6. Provide with non-overloading characteristics.

7. Provide non-sparking integral spun steel venturie inlet cones.

C. Bearings:

1. Pillow block.
2. Bearings: Permanently lubricated sealed ball bearings.
3. Rated for not less than 200,000 hours of operation with accessible greased fittings.

D. Housings: 12 gauge, 0.1046 inch aluminized steel with plenums integral to general housing and constructed to Class 1 fan standards.

E. Motors:

1. Motors: Open drip proof.
2. Efficiency: High.
3. Speed: Single.
4. Control: Variable Frequency Drive.
5. Fan Motor: UL listed and labeled.

F. Drives:

1. Fans: Belt driven.
2. Horsepower: 7.5 hp.
3. Service Factor: 1.2.

2.5 FILTERS

- A. Efficiency: 13 MERV.
- B. Exhaust and Fresh Air Streams: MERV 13 filters constructed to meet ASHRAE Std 52.2.
- C. Filter Racks: Bolt-on rack constructed of 0.08-inch thick aluminum, minimum, with hinged side access door and snap fasteners.
- D. Mount 1/2-inch thick, permanent, aluminum, washable type filter in outside air hood and in return air plenum.
- E. Provide spare set of filters.

2.6 DAMPERS

A. Exhaust Back-Draft Damper: Factory installed, galvanized steel.

1. High performance, backdraft dampers suitable for application in HVAC systems with velocities to 3000 fpm.
2. Louvers, Dampers, and Shutters: AMCA 500-D and AMCA 500-L.
3. Damper Capacity: Demonstrate damper capacity to withstand HVAC system operating conditions.
 - a. Closed position: 6 in-wc.
 - b. Open position: 3,000 fpm.
4. Fabrication:
 - a. Frame: 20 gauge, 0.0359 inch, 3 inch roll formed galvanized steel channel with rear flange, prepunched mounting holes, and welded corner clips for maximum rigidity.
 - b. Blades:
 - 1) Style: Single-piece, overlap frame.
 - 2) Material: Roll formed 28 gauge, 0.0149-inch galvanized steel.
 - 3) Width: Maximum 6 inches.
 - c. Blade Seals: Extruded vinyl, mechanically attached to the blades edge.
 - d. Linkage: Galvanized steel tie bar with stainless steel pivot pins mounted on blades.
 - e. Axles: Stainless steel.
 - f. Mounting: Vertical.

B. Return Air Damper:

1. Factory installed, adjustable volume control, opposed blade damper for regulating airflow, based on external static pressure.
2. Return Air Damper: Structural hat channels, reinforced at corners.
3. Roll-formed Frames: Structurally superior to 13 gauge, 0.0897 inch U-channel frames.
4. Blades: Single skin, 16 gauge, 0.0598 inch.

- C. Motorized Dampers: Provide motorized dampers at outside air inlet, exhaust air outlet, and supply air outlet.
 - 1. Type: Motorized two position parallel blade damper with blade seals.
 - 2. Motorized Damper: Roll-formed structural hat channels, reinforced at the corners,
 - 3. Blades: Single skin, 16 gauge, 0.0598 inch.
- D. Motorized Louvers:
 - 1. Type: Motorized two position parallel blade louver with drainable blades, blade seals, and jamb seals
 - 2. Adjustable louver:
 - a. Fabrication: Mullion style.
 - 1) Frame:
 - a) Material: Extruded aluminum, Alloy 6063-T5.
 - 2) Blades:
 - a) Style: Horizontal, adjustable, drainable.
 - b) Material: Formed aluminum, Alloy 6063-T5.

2.7 VIBRATION ISOLATION

- A. Vibration Isolation: Provide whole unit vibration isolation with the energy recovery unit assembly.

2.8 POWER AND CONTROLS

- A. Motor Control Panels: UL listed.
- B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.
- C. Provide single-point field connection to power supply.
- D. Provide non fused main disconnect integral to control panel.
- E. Install wiring in accordance with NFPA 70.
- F. Wiring: Enclosed in flexible, liquid tight steel conduit.

2.9 ACCESSORIES

A. Airflow Meter:

1. Include integral airflow meter station or probe for ventilation, supply, or exhaust airflow in cfm as indicated on drawings.

B. Electric Preheat Coil:

1. Resistance coil type with elements enclosed in a steel sheath with fins and painted with a baked-on aluminum paint for long life in a 100 percent outdoor air stream.
2. Coil: UL listed and constructed in accordance with NFPA 70 requirements.

2.10 SERVICE ACCESSORIES

A. Internal Service Lights: Provide vapor tight light with protective cage and minimum 40 watt bulb.

B. Electrical Receptacle:

1. Provide duplex, ground fault interrupter type receptacle.

C. Switch: 2 type.

1. Two Position Type: Service and operate.

D. Electrical Components: Factory wired for single point power connection.

1. 60 Hz power connection.
2. Protect all integral wires and connections.
3. Electrical Components: UL Listed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that structure is ready for installation of unit, that openings in deck for ductwork, if required, are correctly sized and located, and that mechanical and electrical utilities supplying unit are of correct capacities and are accessible.

3.2 INSTALLATION

- A. Provide openings for suitable ductwork connection.

3.3 SYSTEM STARTUP

- A. Provide services of manufacturer's authorized representative to provide start up of unit.

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3.4 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

END OF SECTION 237223

SECTION 238129
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air-source outdoor units.
- B. Refrigerant piping.
- C. Refrigerant branch units.
- D. Indoor units.

1.2 RELATED REQUIREMENTS

- A. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.
- B. Section 230719 - HVAC Piping Insulation.
- C. Section 230800 - Commissioning of HVAC.
- D. Section 232300 - Refrigerant Piping.
- E. Section 237223 - Packaged Air-to-Air Energy Recovery Units.
- F. Section 250800 - Commissioning of Integrated Automation.
- G. Section 251500 - Integrated Automation Software.
- H. Section 284400 - Refrigerant Detection and Alarm.
- I. Section 284400 - Refrigerant Detection and Alarm.

1.3 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment; 2021.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2025).
- E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).

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- F. 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.
- G. ITS (DIR) - Directory of Listed Products; Current Edition.
- H. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, and alternate systems/products, as defined above, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.
- C. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents:

1. Outdoor Units:

- a. Refrigerant Type and Size of Charge.
- b. Output and Input Cooling Capacity: Btu/h.
- c. Output and Input Heating Capacity: Btu/h.
- d. Operating Temperature Range, Cooling and Heating.
- e. Fan Capacity: Flow in cfm with respective fan curves.
- f. External Static Pressure (ESP): In-wc.
- g. Sound Pressure Level: dB(A).
- h. Electrical Data: Complete including motor size.
- i. Maximum number of indoor units that can be served.
- j. Maximum refrigerant piping run from outdoor unit to indoor unit(s).
- k. Maximum height difference between outdoor unit to Indoor unit(s), both above and below.

2. Indoor Units:
 - a. Output and Input Cooling Capacity: Btu/h.
 - b. Output and Input Heating Capacity: Btu/h.
 - c. Fan Capacity: Flow in cfm with respective fan curves.
 - d. External Static Pressure (ESP): In-wc.
 - e. Electrical Data: Complete including motor size.
 - f. Maximum Lift of Built-in Condensate Pump.
3. Control Panels: Complete data of controllers, input-output points, and zones.
- D. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
 1. Detailed piping diagrams, with branch balancing devices.
 2. Condensate piping routing, size, and pump connections.
 3. Detailed power wiring diagrams.
 4. Detailed control wiring diagrams.
 5. Locations of required access through fixed construction.
 6. Drawings required by manufacturer.
- E. Design Data:
 1. Provide design calculations showing that system will achieve performance specified.
 2. Provide design data with respective calculations for respective climate zone in accordance with ASHRAE Std 90.1 I-P, ASHRAE Std 15, and ASHRAE Std 34.
- F. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- G. Operating and Maintenance Data:
 1. Manufacturer's complete standard instructions for each unit of equipment and control panel.

2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
 3. Identification of replaceable parts and local source of supply.
- H. Warranty: Executed warranty, made out in Owner's name. Warranty shall be 10 year parts, 2 year labor from the original equipment manufacturer. Contractor or 3rd party warranties shall not be acceptable.
- I. Project Record Documents: Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
 2. Locations of access panels.
 3. Locations of control panels.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
 2. Company that provides system design software to installers.
- B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Mitsubishi Electric Trane HVAC US, LLC; _____: www.metahvac.com/#sle.
- B. Substitutions: Systems designed and manufactured by other manufacturers will be considered by Owner under the terms described for substitutions with the following exceptions:
1. Substitutions: See Section 016000 - Product Requirements.
 2. Substitution requests will be considered only if received at least 10 days prior to the bid date.
 3. Substitution requests will be considered only if submitted data meets or exceed requirements listed in this section.

4. Contractor (not equipment supplier) shall certify that the use of the substitute system and equipment will not require changes to other work or re-design by Engineer.
5. Contractor or HVAC subcontractor shall certify that the substitute system will achieve the performance specified.
6. Do not assume substitution has been accepted until formal written notice has been issued by Engineer.

2.2 VARIABLE REFRIGERANT FLOW SYSTEM

A. Minimum System Requirements:

1. System Testing, Capacity Rating, and Performance:
 - a. AHRI 1230 when cooling capacity is equal or greater than 65,000 Btu/h.
 - b. AHRI 210/240 when cooling capacity is below 65,000 Btu/h.
2. Safety Certification: Bear UL 1995 tested and ITS (DIR) listed certification label.
3. Outdoor Units: Furnish installation and surface support hardware products in accordance with ASCE 7 for wind restraint.
4. Indoor Air Quality or IAQ:
 - a. Provide filtered outdoor air ventilation as indicated on drawings using the integrated method using ERV upstream of indoor units; see Section 237223.
5. Cooling Mode Interior Performance:
 - a. Daytime Setpoint: 75 degrees F, plus or minus 2 degrees F.
 - b. Setpoint Range: 57 degrees F to 77 degrees F.
 - c. Night Setback: 78 degrees F.
 - d. Interior Relative Humidity: 50 percent, maximum.
6. Heating Mode Interior Performance:
 - a. Setpoint: 70 degrees F, plus or minus 2 degrees F.
 - b. Setpoint Range: 59 to 80 degrees F.
 - c. Night Setback: 66 degrees F.
 - d. Minimum Interior Relative Humidity: 10 percent RH.

B. System Design and Installation Considerations:

1. Conditioned spaces and zones are indicated on drawings.
2. Outside unit locations are indicated on drawings.
3. Indoor unit locations are indicated on drawings.
4. Branch refrigerant unit locations are indicated on drawings.
5. Required equipment unit capacities are indicated on drawings.
6. Refrigerant piping sizes are not indicated on drawings.
7. Condensate piping to nearest drain is indicated on drawings.
8. Provide calculations showing ASHRAE Std 15 guideline compliance.

2.3 AIR-SOURCE OUTDOOR UNITS

A. Manufacturers:

1. Heat Recovery, Cooling and Heating Outdoor Units:
 - a. Mitsubishi Electric Trane HVAC US, LLC; _____:
www.metahvac.com/#sle.

B. Heat Recovery Type:

1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.
2. Manifold two or to three units as recommended by manufacturer to handle sequencing and coordination of multiple indoor units.

C. Unit Cabinet:

1. Capable of being installed with wiring and piping to the left, right, rear or bottom.
2. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
3. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
4. Sound Pressure Level: 55 dB measured at 3 feet from front of unit.

D. Heat Sink Side:

1. Condenser Fans:

- a. Provide minimum of 2 fans for each condenser within the outdoor unit.
 - b. Minimum External Static Pressure: Factory set at 0.12 in-wc.
 - c. Fan Type: Vertical discharging, direct-driven propeller type with variable speed operation using DC-controlled ECM motors mechanically connected using permanently lubricated bearings having whole assembly protected with fan guards.
2. Condenser Coils:
- a. Hi-X seamless copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

E. Refrigeration Side:

- 1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).
- 2. Refrigeration Circuit: Inverter driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
- 3. Refrigerant: R-32 or R-454B factory charged. Controller to alarm when charge is below capacity.
- 4. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
- 5. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
- 6. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
- 7. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
- 8. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.

9. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.

F. Local Controls:

1. Include factory-wired instruments, sensors, switches, and safeties for unit control.
2. Configured to coordinate internal unit operation with remote indoor units and with built-in capacity to coordinate other manifolded outdoor units and remote refrigerant branch unit(s).
3. Include screen and button interface to setup operating schedules, setpoints, alarms, and remote unit setpoint coordination. Also used for system troubleshooting.
4. Self diagnostic, auto-check functions to detect malfunctions and display the type and location.

G. Power:

1. Electrical Requirement: 208 VAC, 3-phase, 60 Hz.
2. Outdoor Mounted: Provide fused NEMA EN 10250 Type 4X disconnect switch.

2.4 REFRIGERANT PIPING

- A. The basis of design is a 2-pipe VRF system. In the event the mechanical contractor installs a non-basis 3-pipe system, and all cost changes from the base 2-pipe system shall be 100% borne by the contractor at no additional cost to the Owner.
- B. Two-Pipe Run: Provide low-pressure vapor and high-pressure vapor gas pipes for each indoor unit selected for seasonal heating or cooling service.
- C. Three-Pipe Run: Provide low-pressure vapor, high-pressure vapor gas, and liquid pipes for each indoor unit selected for off-season heating and cooling changeover service.
- D. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

2.5 REFRIGERANT BRANCH UNITS

A. Manufacturers:

1. Mitsubishi Electric Trane HVAC US, LLC; _____: www.metahvac.com/#sle.

- B. Outdoor unit interface to handle two or more indoor units required to do automatic off-season heating and cooling changeover.

- C. Concealed box consisting internally-piped refrigeration loops, subcooling heat exchanger, and other devices coordinated by electronic valves to facilitate off-season load management between outdoor and indoor units. Shall have the ability to service the branch controller from the bottom and not replace the entire unit.
- D. Minimum Requirements:
 - 1. Control direction of refrigerant flow using electronic expansion valves; use of solenoid valves for changeover and pressure equalization is not permitted due to refrigerant noise; use of multi-port branch selector boxes is not permitted unless spare ports are provided for redundancy.
 - 2. Provide one electronic expansion valve for each downstream indoor unit served except when multiple indoor units are connected, provide balancing joints in downstream piping to keep total capacity within branch unit capacity.
 - 3. Energize subcooling heat exchanger during simultaneous heating and cooling service.
 - 4. Casing: Galvanized steel sheet with flame and heat resistant foamed polyethylene sound and thermal insulation.
 - 5. Refrigerant Connections: Braze type.
 - 6. Condensate Drainage: Provide unit that does not require condensate drainage.

2.6 INDOOR UNITS

- A. Minimum Unit Requirements:
 - 1. DX Evaporator Coil:
 - a. Copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
 - b. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch and flare end-connections.
 - c. Provide thermistor on liquid and gas lines wired into local controller.
 - d. Refrigerant circuits factory-charged with dehydrated air for field charging.
 - e. The system shall continue to operate if any individual Indoor Unit is powered down or loses power.
 - 2. Fan Section:
 - a. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.

- b. Thermally protected, direct-drive motor with statically and dynamically balanced fan blades.
 - c. Minimum-adjustable external static pressure 0.32 in-wc; provide for mounting of field-installed ducts.
- 3. Local Unit Controls:
 - a. Exposed Thermostat: Wall-mounted thermostat wired into controller.
 - b. Temperature Control: Return air control using thermistor tied to computerized Proportional-Integral-Derivative (PID) control of superheat.
 - c. Temperature Zones:
 - 1) Single Indoor Unit: Set served space(s) as the local temperature zone.
 - 2) Multiple Indoor Units: For large zones, group and coordinate related indoor units with served spaces as the local temperature zone with each indoor unit as sub-zone.
 - d. Humidity Control:
 - 1) Provide sensor(s), switches, devices, wiring terminal interface, and sequences.
 - 2) Dehumidification: Apply for ventilated units and units sized for latent loads. Adjustable target VRF evaporator temperatures shall optimize coverage of latent and sensible heat.
 - e. Additional Temperature Sensors: Provide wall-mounted temperature sensors as indicated on drawings for each indoor unit.
- 4. Return Air Filter:
 - a. High efficiency, MERV 13, monitored with adjustable static pressure switch.
 - b. Provide air filter rack for non-manufacturer's standard filters.
- 5. Condensate:
 - a. Built-in condensate drain pan with PVC drain connection for drainage.
 - b. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
 - c. Units Without Built-In Condensate Pump: Provide built-in condensate float switch and wiring connections.

6. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

B. Ceiling-Concealed Ducted Indoor Units:

1. Manufacturers:
 - a. Ceiling-Concealed Ducted Indoor Units:
 - 1) Mitsubishi Electric Trane HVAC US, LLC; _____:
www.metahvac.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
2. Type: Ducted unit with DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
3. Ducted horizontal discharge and side or back-end return; galvanized steel cabinet.
4. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
5. Return Air Filter: High efficiency, MERV 13.
6. Sound Pressure: Measured at low speed at 5 feet below unit.
7. Provide external static pressure switch adjustable for high efficiency filter operation
8. Condensate Pump: Built-in, with lift of 9 inches, minimum.
9. Switchbox accessible from side or bottom.
10. Provide dehumidification control as indicated on drawings.

C. Wall Mounted, Indoor Units:

1. Manufacturers:
 - a. Mitsubishi Electric Trane HVAC US, LLC; _____:
www.metahvac.com/#sle.
2. DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
3. Variable or three-speed ECM cross-flow fan with automatic airflow adjustment; external static pressure selectable during commissioning.

4. Return Air Filter: High efficiency, MERV 13.
5. Provide exposed unit casing with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
6. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaults to same angle as previous operation.
7. Sound Pressure Range: Measured at low speed at 3.3 feet below and away from unit.
8. Condensate Drain Connection: Back, with piping concealed in wall.

D. Refrigerant Leak Detection

1. Sequence upon receiving leak detection signal from any DX indoor unit:
 - a. Shut-off valves for each port(s) connected DX indoor unit(s) having detected refrigerant close.
 - b. If indoor unit fan(s) where refrigerant is detected is set to AUTO, fan switches to ON.
 - c. Refrigerant detection signal output activated.
 - d. Normal operation continues uninterrupted for ports and DX indoor units where refrigerant is not detected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify Engineer if conditions for installation are unsatisfactory.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

- D. Coordinate with installers of systems and equipment connecting to this system.
- E. Refrigerant Piping: See Section 232300 with Section 230719 for insulation, and Section 230529 for hangers and supports unless following specific manufacturer recommendations.
- F. Connect indoor units to condensate piping.
- G. Coordinate BAS, BMS, or Integrated Automation linking between local controller(s) and remote front-end interface; see Section 251500.
- H. Install refrigerant leak detection and alarm system in occupied spaces; see Section 284400.
- I. Provide refrigerant detection systems for units and piping; see Section 284400.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide manufacturer's field representative to inspect installation prior to startup.

3.4 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform system startup.
- B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.5 CLEANING

- A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.6 COMMISSIONING

- A. See Section 019113 - General Commissioning Requirements for additional requirements.
- B. Execute mechanical system commissioning as indicated on Section 230800.
- C. Execute BAS, SCADA, or other linked integration automation system commissioning as indicated on Section 250800.
- D. Replace components not functioning properly.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.

- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Conduct walking tour of project.
 - 3. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's training personnel.
 - 4. Location: At project site.

3.8 PROTECTION

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

3.9 MAINTENANCE

- A. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION 238129

SECTION 238200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electric unit heaters.
- B. Electric cabinet unit heaters.
- C. Thermostatic controls.

1.2 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.3 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. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 SUBMITTALS

- A. See Section 013000 - 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.
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

- E. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- H. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.5 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

2.1 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. Ouellet: www.ouellet.com/#sle.
 - 4. Berko/Marley Engineered Products: www.marleymep.com.
- 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. Steel fins copper brazed to steel sheath and epoxy sealed for moisture resistance.
 - D. Housing:
 - 1. Suitable for ceiling or high altitude mount using provided hardware appendages.
 - 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. Built-in line-voltage thermostat.
 - I. Electrical Characteristics:
 - 1. Disconnect Switch: Factory mount disconnect switch.
- 2.2 ELECTRIC CABINET UNIT HEATERS
- A. Manufacturers:
 - 1. INDEECO (Industrial Engineering and Equipment Company); _____: www.indeeco.com/#sle.
 - 2. Berko / Marley Engineered Products; _____: www.marleymep.com/#sle.
 - 3. Ouellet; _____: www.ouellet.com/#sle.
 - 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 ceiling, duct, recessed, semi-recessed, surface, or wall mounting.
- E. Finish:
 - 1. Factory applied, painted finish.
 - 2. Color: As selected by architect..
- F. Controls:
 - 1. Built-in line-voltage thermostat.

2.3 THERMOSTATIC CONTROLS

- A. Programmable Thermostats:
 - 1. Manufacturers:
 - a. Honeywell International, PLC; _____:
buildingcontrols.honeywell.com/#sle.
 - 2. Digital electronic type with key- or pushbutton-operated display.
 - 3. Programmable occupied/unoccupied weekly and holiday schedule.
 - 4. Surface or single-gang mounted base; include accessories.
 - 5. Internal digital controller with platinum or thermistor sensor:
 - a. Units in degrees F and degrees C, selectable.
 - b. 2-Speed fan control switch with override.
 - c. Filter maintenance indicating status.
 - d. Automatic heating and cooling changeover.
 - e. Setpoint adjustment control with temporary setting.
 - f. Operational status indicator with manual override.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.2 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. Wall 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 260583.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, instruct, and observe.

3.4 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.

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CONVECTION HEATING AND COOLING UNITS

- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals for closeout submittals.
- B. See Section 017900 - Demonstration and Training for additional requirements.

END OF SECTION 238200

SECTION 260505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition.

1.2 RELATED REQUIREMENTS

- A. Section 017000 - Execution and Closeout Requirements: Additional requirements for alterations work.
- B. Section 028400 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.

- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.

END OF SECTION 260505

SECTION 260513
MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Medium voltage cable.
- B. Cable accessories.

1.2 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems.
- B. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes: Cable racks in manholes.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. IEEE 48 - IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV; 2020.
- C. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- D. NEMA WC 71 - Nonshielded Cables Rated 2001-5000 V for Use in the Distribution of Electric Energy; 2014 (Reaffirmed 2022).
- E. NEMA WC 74 - 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy; 2022.
- 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.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for cable, terminations, and accessories.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- D. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.
- E. Maintenance Data: Include instructions for testing and cleaning cable and accessories.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles of Project.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. 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

2.1 MEDIUM-VOLTAGE CABLE

- A. Manufacturers:
 - 1. General Cable Technologies Corporation: www.generalcable.com/#sle.
 - 2. Okonite: www.okonite.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.
 - 4. _____.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Medium Voltage Cable: NEMA WC 70 rubber insulated cable.
 - 1. Voltage: 15 kV, grounded.
 - 2. Insulation Jacket: PVC.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that conduit, duct, trench, or manholes are ready to receive cable.
- B. Verify that field measurements are as indicated.
- C. Verify routing and termination locations of cable bank prior to rough-in.
- D. Cable routing is shown in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 PREPARATION

- A. Use swab to clean conduits before pulling cables.

3.3 INSTALLATION

- A. Avoid abrasion and other damage to cables during installation.
- B. Use suitable lubricants and pulling equipment.
- C. Sustain cable pulling tensions and bending radii below recommended limits.
- D. Ground cable shield at each termination and splice.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect exposed cable sections for physical damage.
- C. Inspect cable for proper connections as indicated.
- D. Inspect shield grounding, cable supports, and terminations for proper installation.

3.5 PROTECTION

- A. Protect installed cables from entrance of moisture.

END OF SECTION 260513

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SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Nonmetallic-sheathed cable.
- C. Underground feeder and branch-circuit cable.
- D. Service entrance cable.
- E. Armored cable.
- F. Metal-clad cable.
- G. Wiring connectors.
- H. Electrical tape.
- I. Heat shrink tubing.
- J. Oxide inhibiting compound.
- K. Wire pulling lubricant.
- L. Cable ties.
- M. Firestop sleeves.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).

- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- H. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
- I. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2024.
- J. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- K. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- O. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- P. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- Q. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- R. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- S. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- T. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- U. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.
- V. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.4 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 Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - 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. Wire Pulling Lubricant: Certification of compatibility with conductors/cables where used with the following insulation/jacket types:
 1. Low-smoke zero halogen (LSZH).
- D. Field Quality Control Test Reports.
- 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 circuiting arrangements. Record actual routing for underground circuits.

1.6 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. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 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

2.1 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.

2.2 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. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. 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.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.

H. 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.
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.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servicewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
 - f. Substitutions: See Section 016000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.

2.4 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:

1. Cerro Wire LLC: www.cerrowire.com/#sle.
2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Service Wire Co: www.servicewire.com/#sle.
4. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.

C. Provide equipment grounding conductor unless otherwise indicated.

D. Conductor Stranding:

1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Cable Jacket: Listed and labeled as sunlight resistant.

2.5 SERVICE ENTRANCE CABLE

A. Manufacturers:

1. Copper Service Entrance Cable:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. Service Wire Co: www.servicewire.com/#sle.

- B. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.
- C. Conductor Stranding: Stranded.
- D. Insulation Voltage Rating: 600 V.

2.6 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Grounding: Full-size integral equipment grounding conductor.
- G. Armor: Steel, interlocked tape.

2.7 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. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
- C. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- D. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. NSI Industries LLC: www.nsiindustries.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- F. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. nVent ILSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. nVent ILSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.

- d. Substitutions: See Section 016000 - Product Requirements.
- H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.8 ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
 - 2. 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.
 - 3. 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.
 - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

1. Manufacturers:

- a. 3M: www.3m.com/#sle.
- b. Burndy LLC www.burndy.com/#sle.
- c. Thomas & Betts Corporation: www.tnb.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

1. Manufacturers:

- a. Burndy LLC: www.burndy.com/#sle.
- b. Ideal Industries, Inc: www.idealindustries.com/#sle.
- c. IlSCO: www.ilsco.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

- D. Wire Pulling Lubricant:

1. Manufacturers:

- a. 3M: www.3m.com/#sle.
- b. American Polywater Corporation: www.polywater.com/#sle.
- c. Ideal Industries, Inc: www.idealindustries.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

2. Listed and labeled as complying with UL 267.

3. Suitable for use at installation temperature.

4. Products:

- a. American Polywater Corporation; Polywater J Cable Pulling Lubricant: www.polywater.com/#sle.
- b. American Polywater Corporation; Polywater LZ Cable Pulling Lubricant: www.polywater.com/#sle.
- c. Substitutions: See Section 016000 - Product Requirements.

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- E. Cable Ties: Material and tensile strength rating suitable for application.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- F. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 - 1. When circuit destination is indicated without specific routing, determine exact routing required.
 - 2. Arrange circuiting to minimize splices.
 - 3. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.

4. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- I. Terminate cables using suitable fittings.
 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - 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 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 260519

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.
- E. Ground enhancement material.
- F. Ground access wells.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 263100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
- D. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
- E. Section 337900 - Site Grounding.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- 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.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. 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.
- D. Field quality control test reports.
- E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 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. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- 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.
 - 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. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 4. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground enhancement material around electrode where indicated.
 - e. Provide ground access well for each electrode.
 5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- F. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- G. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the

derived system. Make connection at same location as grounding electrode conductor connection.

4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

H. 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.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.2 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 260526:

1. Use insulated copper conductors unless otherwise indicated.

a. Exceptions:

- 1) Use bare copper conductors where installed underground in direct contact with earth.
- 2) Use bare copper conductors where directly encased in concrete (not in raceway).

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. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

a. Exceptions:

- 1) Use exothermic welded connections for connections to metal building frame.

4. Manufacturers - Mechanical and Compression Connectors:

- a. allG Fabrication: www.allgfab.com/#sle.
- b. Burndy LLC: www.burndy.com/#sle.
- c. Harger Lightning & Grounding: www.harger.com/#sle.
- d. nVent ERICO: www.nvent.com/#sle.
- e. Thomas & Betts Corporation: www.tnb.com/#sle.
- f. Substitutions: See Section 016000 - Product Requirements.

5. Manufacturers - Exothermic Welded Connections:

- a. Burndy LLC: www.burndy.com/#sle.
- b. nVent ERICO; Cadweld: www.nvent.com/#sle.

- c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC:
www.thermoweld.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. 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. allG Fabrication: www.allgfab.com/#sle.
 - b. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. nVent ERICO: www.nvent.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- E. Ground Enhancement Material:
 - 1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
 - 2. Resistivity: Not more than 20 ohm-cm in final installed form.
 - 3. Manufacturers:
 - a. Harger Lightning & Grounding: www.harger.com/#sle.
 - b. nVent ERICO; GEM: www.nvent.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC:
www.thermoweld.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- F. Ground Access Wells:
 - 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 - 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.

- a. Round Wells: Not less than 8 inches in diameter.
- 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
- 4. Cover: Factory-identified by permanent means with word "GROUND".
- 5. Manufacturers:
 - a. allG Fabrication: www.allgfab.com/#sle.
 - b. nVent ERICO: www.nvent.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. 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.
- D. Make grounding and bonding connections using specified connectors.
 - 1. 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.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - 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 260526

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SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 Section Includes

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 Related Requirements

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- D. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- E. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- F. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 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; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 Administrative Requirements

- A. Coordination:

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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 033000.

1.5 Submittals

- A. See Section 013000 - 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.

1.6 Quality Assurance

- A. Maintain at project site one copy of each referenced document that prescribes execution requirements.
- B. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.
- C. Installer Qualifications for Field Welding: See Section 055000.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 Delivery, Storage, and Handling

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 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. 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. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.

- b. Eaton Corporation: www.eaton.com/#sle.
- c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
- d. HoldRite, a brand of Reliance Worldwide Corporation:
www.holdrite.com/#sle.
- e. Substitutions: See Section 016000 - Product Requirements.

D. Metal Channel/Strut Framing Systems:

- 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - c. Eaton Corporation: www.eaton.com/#sle.
 - d. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- 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.
- 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
- 6. Minimum Channel Dimensions: 1-5/8 inch (41 mm) wide by 13/16 inch (21 mm) high.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

- 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch (13 mm) diameter.
 - b. Busway Supports: 1/2-inch (13 mm) diameter.
 - c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.

- d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.
- e. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
- f. Outlet Boxes: 1/4-inch (6 mm) diameter.

F. Anchors and Fasteners:

- 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- 2. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
- 3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- 4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 5. Hollow Masonry: Use toggle bolts.
- 6. Hollow Stud Walls: Use toggle bolts.
- 7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
- 8. Sheet Metal: Use sheet metal screws.
- 9. Wood: Use wood screws.
- 10. Plastic and lead anchors are not permitted.
- 11. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.

- d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.

PART 3 EXECUTION

3.1 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.

3.2 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. 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.
- H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners in accordance with manufacturer's recommended torque settings.

J. Remove temporary supports.

3.3 Field Quality Control

A. See Section 014000 - 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 260529

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SECTION 260533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 078400 - Firestopping.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.
- D. Section 260526 - Grounding and Bonding for Electrical Systems.
- E. Section 260529 - Hangers and Supports for Electrical Systems.
- F. Section 260533.16 - Boxes for Electrical Systems.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- I. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.

- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- D. ASTM D1002 - Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal); 2010 (Reapproved 2019).
- E. ASTM D1598 - Standard Test Methods for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure; 2021.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- I. NEMA BI 50058 - Electrical Nonmetallic Tubing (ENT); 2014 (Reaffirmed 2019).
- J. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- K. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- L. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- M. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- P. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- Q. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- R. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- S. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- T. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- U. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.
- V. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

- W. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.4 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.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.6 QUALITY ASSURANCE

- A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 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. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
 - 4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, or PVC-coated galvanized steel rigid metal conduit (RMC) elbows for bends.
 - 6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
- D. Embedded Within Concrete:
 - 1. Within Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit (RMC). Embed within structural slabs only where approved by Structural Engineer.
 - 2. Within Slab Above Ground: Not permitted.

3. Within Slab Above Ground: Use galvanized steel rigid metal conduit (RMC). Embed within structural slabs only where approved by Structural Engineer.
 4. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit (RMC) or reinforced thermosetting resin conduit (RTRC).
 5. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel intermediate metal conduit (IMC) or galvanized steel electrical metallic tubing (EMT) where emerging from concrete.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel intermediate metal conduit (IMC).
- G. Concealed Above Accessible Ceilings: Use galvanized steel intermediate metal conduit (IMC).
- H. Interior, Damp or Wet Locations: Use galvanized steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel intermediate metal conduit (IMC).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC).
1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
- K. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- L. Exposed, Exterior, Not Subject to Severe Physical Damage: Use PVC-coated galvanized steel rigid metal conduit (RMC).
- M. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
1. Maximum Length: 6 feet (1.8 m).
- N. Flexible Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit (FMC).
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.

4. Vibrating equipment includes, but is not limited to:

- a. Transformers.
- b. Motors.

O. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.2 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Rymco USA: www.rymcousa.com/#sle.
 - 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 - 6. Substitutions: See Section 016000 - 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. Factory-Painted, Color-Coded Galvanized Steel RMC: Apply according to indicated color code.
 - 1. See Section 260553 for color code.

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2. Products:
 - a. Wheatland Tube.
 - b. Atkore.
 - c. RYMCO USA.
 - d. Substitutions: See Section 016000 - Product Requirements.

D. Fittings:

1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Rymco USA: www.rymcousa.com/#sle.
4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
6. Substitutions: See Section 016000 - 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. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.5 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 1. ABB; Ocal: www.electrification.us.abb.com/#sle.
 2. Robroy Industries: www.robroy.com/#sle.
 3. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch (1.02 mm).
- D. PVC-Coated Boxes and Fittings:
 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 3. Material: Use steel or malleable iron.
 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.6 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:

1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 016000 - 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. Manufacturers:

- a. ABB; T&B: www.electrification.us.abb.com/#sle.
- b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
- c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:

1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 016000 - 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. Manufacturers:

- a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.8 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

- 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
- 2. Nucor Tubular Products: www.nucortubular/#sle.
- 3. Rymco USA: www.rymcousa.com/#sle.
- 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
- 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- 6. Substitutions: See Section 016000 - Product Requirements.

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. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
- 3. Material: Use steel or malleable iron.
- 4. Connectors and Couplings: Use compression/gland or set-screw type.

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- a. Do not use indenter type connectors and couplings.

2.9 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:

1. ABB; Carlon: www.carlon.com/#sle.
2. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
3. Cantex Inc: www.cantexinc.com/#sle.
4. Heritage Plastics, a division of Atkore International: www.heritageplastics.com/#sle.
5. JM Eagle: www.jmeagle.com/#sle.
6. Rymco USA: www.rymcousa.com/#sle.
7. Substitutions: See Section 016000 - 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.

2.10 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 (5.6 kN).

D. Foam Conduit Sealant:

1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.

2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 3. Rated to hold minimum of 10 ft (3.0 m) water head pressure.
 4. Products:
 - a. American Polywater Corporation; Polywater FST Foam Duct Sealant: www.polywater.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- E. Conduit Mechanical Seals:
1. Listed as complying with UL 514B.
 2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 3. Suitable for sealing around conductors/cables to be installed.
 4. Products:
 - a. American Polywater Corporation; PHRD SG Mechanical Seals: www.polywater-haufftechnik.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- F. Sealing Systems for Concrete Penetrations:
1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
 3. Products:
 - a. American Polywater Corporation; PHSD Mechanical Seals: www.polywater-haufftechnik.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

- b. Hilti.
 - c. Unique Fire Stop Products.
 - d. Substitutions: See Section 016000 - Product Requirements.
- H. 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.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
 - b. Cal Am.
 - c. Formex.
 - d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 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.

3.2 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. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.
- F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- 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 260529.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

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.
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. Conceal bends for conduit risers emerging above ground.
5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. 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.
7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

- 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.
 3. Where conduits are subject to earth movement by settlement or frost.
- 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 enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. 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 grounding and bonding; see Section 260526.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 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 260533.13

SECTION 260533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Floor boxes.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.13 - 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.
- F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 262726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Poke-through assemblies.
 - 4. Access floor boxes.
 - 5. Additional requirements for locating boxes for wiring devices.

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1.3 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. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.4 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 Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for 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.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 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 (1,650 cu cm), 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.
 - b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
 13. Wall Plates: Comply with Section 262726.
 14. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation:
www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.

- c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 016000 - Product Requirements.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
- 1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, galvanized steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Floor Boxes:
- 1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 - 2. Use sheet-steel or cast iron floor boxes within slab above grade.
 - 3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).

4. Manufacturer: Same as manufacturer of floor box service fittings.

2.2 ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
 1. Manufacturers:
 - a. Quickflash Weatherproofing Products, Inc:
www.quickflashproducts.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 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.

3.2 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. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.

2. 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 260533.13.
- H. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 260529 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.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 260526.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260533.16

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 099113 - Exterior Painting.
- B. Section 099123 - Interior Painting.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. 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.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.7 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 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.
 - 4) 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.
 - c. Time Switches:
 - 1) Identify load(s) served and associated circuits controlled. Include location.
 - d. Electricity Meters:
 - 1) Identify load(s) metered.
 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
 4. 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 including but not limited to the following.
 - a. Service equipment.
- B. Identification for Conductors and Cables:
 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
 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.
- 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 099123 and 099113.

3. Use underground warning tape to identify underground raceways.
4. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 262726.
2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
3. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

F. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - c. Seton Identification Products: www.seton.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

3. 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.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. 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. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.

5. Color:
 - a. Normal Power System: White text on black background.
 - 1) 208Y/120 V, 3 Phase Equipment: White text on Black background.

D. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

E. Format for Control Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.
2. HellermannTyton: www.hellermannntyton.com/#sle.
3. Panduit Corp: www.panduit.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. 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.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. 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 Pull Boxes: 1 1/8 by 4 1/2 inches.
 - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
 - 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
 - b. Other Systems: Type of service.
- F. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:

1. Tape for Buried Power Lines: Black text on red background.

2.6 WARNING SIGNS AND LABELS

A. Manufacturers:

1. Brimar Industries, Inc: www.brimar.com/#sle.
2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
3. Insite Solutions, LLC: www.stop-painting.com/#sle.
4. Seton Identification Products: www.seton.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:

1. Materials:

- a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
- b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.

3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:

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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.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 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. Interior Components: Legible from the point of access.
 6. Conduits: Legible from the floor.
 7. Boxes: Outside face of cover.
 8. Conductors and Cables: Legible from the point of access.
 9. 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.
- 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. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - 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 260553

SECTION 260583
WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.
- E. Section 262816.16 - Enclosed Switches.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- 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

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 262726.
- D. Flexible Conduit: As specified in Section 260533.13.
- E. Wire and Cable: As specified in Section 260519.
- F. Boxes: As specified in Section 260533.16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.

- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 260583

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SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 Section Includes

- A. Occupancy sensors.
- B. Daylight Harvesting sensors.
- C. Dimming switches.
- D. Control panels.
- E. Power supplies.
- F. Power packs.
- G. Digital load controllers.
- H. Accessories.

1.2 Related Requirements

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems
- D. Section 260533.16 - Boxes for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches and wall dimmers.
- G. Section 265100 - Interior Lighting.

1.3 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. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

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- E. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.4 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 265100 and lighting fixture schedule.
6. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 Submittals

- A. See Section 013000 - 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. Shop Drawings:

1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
2. Digital Load Controllers: Provide dimensioned plan views indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing factory and field connections. Include manufacturer product characteristics and application instructions for wired and wireless applications, including start-up and commissioning.

- 3. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Field quality control reports.
- 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 detailed information on device programming and setup.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual installed locations and settings for lighting control devices.
- 1.6 Quality Assurance
 - A. Comply with NFPA 70.
- 1.7 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.
- 1.8 Field Conditions
 - A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- 1.9 Warranty
 - A. See Closeout Submittal procedures for warranty requirements.
 - B. Provide 2 year manufacturer warranty for occupancy sensors.
 - C. Provide 2 year manufacturer warranty for digital load controllers.

PART 2 PRODUCTS

- 2.1 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.

2.2 Occupancy Sensors

A. Manufacturers:

- 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.

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/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
- 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.

- c. Finish: White.
 - 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet.
- D. Wall Dimmer 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 dimming control capability, and no leakage current to load in off mode.
 - b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - c. Finish: White.
- E. Ceiling Mounted Occupancy Sensors:
- 1. General Requirements:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - 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.
- F. Power Packs for Low-Voltage Occupancy Sensors:
- 1. Description: Plenum rated, self-contained low-voltage class 2 transformer and relay compatible with specified low-voltage occupancy sensors for switching of line-voltage loads.
 - 2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.
 - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 4. Load Rating: As required to control load indicated on drawings.

2.3 Digital Load Controllers

A. Manufacturers:

1. nLight: <https://nlight.acuitybrands.com/>.
2. Sensor Switch Inc: www.sensorswitch.com/#sle.

B. System Description:

1. Stand-alone system, including interconnected modules and accessories, for lighting and plug load low-voltage control as indicated on drawings, schedules, written sequences of operation, and reviewed shop drawings.
2. Product standard system configurations preconfigured out of box, plug-and-play, automatically self-addressing devices for communications, and without need to field configure or program features, or requiring device setting adjustments. LEDs on unit indicate operation and troubleshooting without software intervention.
3. Provide quantity and configuration of power and slave packs, communication modules, and load expansion modules, including associated wiring, wired and wireless components, and accessories to control loads indicated.

C. General Requirements:

1. Listed for powering and controlling line-voltage loads, power packs, contactors, relays, and other lighting control devices.
2. Input Supply Voltage: Dual rated for 120/277 VAC.
3. Cabling Terminations:
 - a. Provide field fabricated, and tested before installation, control wiring.
 - b. Include line and load wiring leads.
4. Provide UL 2043 plenum rated control unit with self-contained relay(s) and low-voltage class 2 transformer, compatible with specified wired and wireless sensors, components, and ballasts/drivers.
 - a. Comply with NFPA 70 for use in plenum spaces.
 - b. Provide UL 2043 plenum rating for associated system control components for control indicated.
5. Surface Mounting: Standard junction box attachments.
6. Provide one auxiliary contact closure output where indicated.
7. Minimum Load Rating: As required to control load indicated on drawings.

- 8. Control Inputs:
 - a. Digital: Two.
 - b. Analog: One.
- 9. Output Control Capability:
 - a. Single Zone Switching Modules: One programmable channel.
 - b. Multi-Zone Switching Modules: Up to three separately programmable channels.

PART 3 EXECUTION

3.1 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.

3.2 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 260533.16.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
- C. Maintain separation of remote-control, signaling, and power-limited circuits.

1. See manufacturer instructions and Section 260519 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. Where required and not furnished with lighting control device, provide wall plate; see Section 262726.
- H. Provide required supports; see Section 260529.
- I. 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.
- J. Occupancy Sensor Locations:
 1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
- K. Daylighting Control Photo Sensor Locations:
 1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize control and avoid conflicts or problems affecting proper detection of light levels.
 2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure light level controlled at designated task location, while minimizing measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into space, while minimizing measured amount of lighting from artificial sources.
- 3.3 Field Quality Control
 - A. See manufacturer's 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. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.4 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 Engineer.
- 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 Engineer. Record settings in written report to be included with submittals.

3.5 Cleaning

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 Commissioning

- A. Commissioning shall be coordinated with manufacturer to ensure proper wiring and programming.

3.7 Closeout Activities

- A. Follow procedures for closeout submittals.
- B. Provide demonstration and training by manufacturer.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Engineer and Owner's representative, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized service representative.

4. Location: At project site.

END OF SECTION 260923

SECTION 261300
MEDIUM-VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Service entrance rated primary combination Switch with Metering compartment.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Pads for transformer support.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.

1.3 REFERENCE STANDARDS

- A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2024.
- B. IEEE C37.04 - IEEE Standard for Ratings and Requirements for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V; 2018 (Corrigendum 2021).
- C. IEEE C37.20.2 - IEEE Standard for Metal-Clad Switchgear; 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.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.
 - 1. Identify mounting conditions required for equipment seismic qualification.
- C. Product Data: Provide electrical characteristics and connection requirements, standard model design tests, and options.
- D. Manufacturer's equipment seismic qualification certification.

- E. Manufacturer's Installation Instructions.
- F. Operation Data: Include operating instructions for manually and electrically opening and closing circuit breakers.
- G. Maintenance Data: Include maintenance instructions for cleaning methods; cleaning materials recommended; instructions for circuit breaker removal, replacement, testing and adjustment, and lubrication.

1.5 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 and with service facilities within 100 miles (160 km) of Project.
- C. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect products from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com/#sle.
- B. Substitutions: See Section 016000 - Product Requirements.

2.2 DESCRIPTION

- A. Medium Voltage Switch: 2-Section metal-clad assembly, comprised of (1) fused disconnect compartment, and (1) metering compartment in free-standing cubicles formed into an integrated structure.

2.3 SERVICE CONDITIONS

- A. Meet requirements for PECO utility company service conditions.

- B. Meet requirements for use as service disconnecting means.

2.4 RATINGS

- A. Seismic Qualification: IBC/CBC Seismic Qualified.
- B. Nominal Voltage: 15 kV, three phase, 60 Hz.
- C. Voltage and Insulation Levels: Comply with IEEE C37.20.2.
- D. Main Bus Ampacity: 600 amperes, continuous.
- E. Momentary Current Rating: To IEEE C37.20.2.

2.5 Compartments

- A. Fused Disconnect Compartment:: Fuses as indicated on contract documents.
- B. Metering Compartment: To accept PECO utility meter.
- C. Rated Maximum Voltage: 15.0 kV.
- D. Rated Voltage Range Factor: 1.3.
- E. Rated Frequency: 60 Hz.
- F. Rated Continuous Current: 600 amperes, rms.

2.6 FABRICATION

- A. Construction: Outdoor.
- B. Main Bus: Tin-Plated Aluminum.

2.7 FACTORY FINISHES

- A. Finish Color: Manufacturer's standard ANSI-61 Light Gray finish.

2.8 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Test in accordance with IEEE C37.20.2.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Resident Project Representative and Utility Company Representative at least 7 days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that support pads furnished under Section 033000 are ready to receive products.

3.2 INSTALLATION

- A. Install in accordance with IEEE C37.20.1.
- B. Provide required support and attachment in accordance with Section 260529.
- C. Install switchgear plumb and level and with each section aligned properly.
- D. Make electrical connections between equipment sections using connectors furnished by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - 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 7.1 .

3.4 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of disconnecting means.

END OF SECTION 261300

SECTION 262100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.13 - Conduit for Electrical Systems.
- F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 262416 - Panelboards: Service entrance equipment.
- H. Section 262816.16 - Enclosed Switches: Service entrance equipment.
- I. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
- J. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.3 PRICE AND PAYMENT PROCEDURES

A. Allowances:

- 1. See Section 012100 - Allowances, for allowances affecting this section.
- 2. Include cash allowance for Utility Company charges associated with providing service.

B. Unit Prices:

- 1. See Section 012200 - Unit Prices, for additional unit price requirements.
- 2. Primary:
 - a. Basis of Measurement: By the lineal foot, for each configuration.

- b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.

3. Transformer Pad/Vault:

- a. Basis of Measurement: Per unit, for each type.
- b. Basis of Payment: Includes purchase, delivery, and installation.

1.4 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.5 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Notify Resident Project Representative of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
 - C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
 - D. Utility Company charges associated with providing permanent service to be paid by Owner.
 - E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
 - F. Scheduling:
 1. Arrange for inspections necessary to obtain Utility Company approval of installation.
- 1.7 SUBMITTALS
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
 - B. Utility Company letter of availability for providing electrical service to project.
 - C. Drawings prepared by Utility Company.
 - D. Project Record Documents: Record actual locations of equipment and installed service routing.
- 1.8 QUALITY ASSURANCE
- A. Comply with the following:
 1. IEEE C2 (National Electrical Safety Code).
 2. NFPA 70 (National Electrical Code).
 3. The requirements of the Utility Company.
 4. The requirements of the local authorities having jurisdiction.
 - B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
 - B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until

completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Electrical Service Characteristics:
 - 1. Service Type: Underground.
 - 2. Service Voltage: 208Y/120 V, 3 phase, 60 Hz.
 - 3. Service Size: 800A.
- D. Utility Company: PECO.
- E. Division of Responsibility: Electrical, Division 26.
- F. Division of Responsibility:
 - 1. Pad-Mounted Utility Transformers:
 - a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
 - b. Transformers: Furnished and installed by Utility Company.
 - c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
 - d. Primary:
 - 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Utility Company.
 - e. Secondary:

- 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Contractor (Service Point at transformer).
2. Terminations at Service Point: Provided by Utility Company.
3. Metering Provisions:
 - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
 - b. Metering Compartments in Service Entrance Equipment: Furnished and installed by Contractor per Utility Company requirements.
 - c. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
- G. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Section 312316.13.
- E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 033000.

- F. Provide required support and attachment components in accordance with Section 260529.
- G. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.
- H. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

3.4 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION 262100

SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Load centers.
- D. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA PB 1 - Panelboards; 2011.
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 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 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 67 - Panelboards; Current Edition, Including All Revisions.

- K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 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 Resident Project Representative of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - 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.
- 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.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

- B. 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.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 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 (-5 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com/#sle.
- B. Schneider Electric: www.se.com/#sle.
- C. Siemens Industry, Inc: www.new.siemens.com/#sle.
- D. Substitutions: See Section 016000 - Product Requirements.
- E. 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.

2.2 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. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- 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.

- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. 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.
 - 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.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.3 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: Aluminum.
 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
- E. Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
- 2.4 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: Aluminum.
 3. Ground Bus Material: Aluminum.
- 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.

2.5 LOAD CENTERS

- A. Description: Circuit breaker type load centers listed and labeled as complying with UL 67; ratings, configurations, and features as indicated on the drawings.
- B. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Bus Material: Aluminum or copper.
- C. Circuit Breakers: Thermal magnetic plug-in type.
- D. Enclosures:
 - 1. Provide flush-mounted enclosures unless otherwise indicated.
 - 2. Provide circuit directory label on inside of door or individual circuit labels adjacent to circuit breakers.

2.6 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 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.

3.2 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. Provide required support and attachment in accordance with Section 260529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
- K. Install all field-installed branch devices, components, and accessories.
- L. Provide filler plates to cover unused spaces in panelboards.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Test GFCI circuit breakers to verify proper operation.
- D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.

3.5 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 262416

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SECTION 262713
ELECTRICITY METERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment for Owner electricity metering:
 - 1. Submetering Devices.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262100 - Low-Voltage Electrical Service Entrance: Requirements for Utility Company electricity metering.
- F. Section 262300 - Low-Voltage Switchgear: For interface with meters specified in this section.
- G. Section 262416 - Panelboards: For interface with meters specified in this section.
- H. Section 262813 - Fuses.

1.3 REFERENCE STANDARDS

- A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- 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.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
 2. Coordinate the work with other installers to provide communication lines required for electricity metering system interface.
 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss electricity metering system interface requirements.
- 1.5 SUBMITTALS
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.
 - C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.
 - D. Project Record Documents: Record actual installed locations of meters and final equipment settings.
 - E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
 - F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Electricity Meters:
 - 1. ABB: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric: www.se.com/#sle.
 - 4. Siemens Industry, Inc: www.new.siemens.com/#sle.
 - 5. SOCOMEC: www.socomec.us/#sle.

2.2 EQUIPMENT FOR OWNER ELECTRICITY METERING

- A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.
- D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.
- E. Enclosures:
 - 1. Where not furnished by manufacturer, provide required cabinets and enclosures.
 - 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.

3. Finish: Manufacturer's standard unless otherwise indicated.

F. Instrument Transformers:

1. Comply with IEEE C57.13, where applicable.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

G. Accessories:

1. Wiring: Provide manufacturer's recommended cables as indicated or as required for connections between system components.
2. IP Network Connections:
 - a. Unless otherwise indicated, network switches required for network connections to system components provided by Contractor.
 - b. Unless otherwise indicated, network cables required for network connections to system components provided by Contractor.
 - 1) Network Cables: Unshielded twisted pair (UTP), minimum Category 5e.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive meters.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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 components in accordance with Section 260529.
- D. Provide grounding and bonding in accordance with Section 260526.
- E. Provide fuses complying with Section 262813 as required.

3.3 FIELD QUALITY CONTROL

- A. Refer to manufacturer's installation procedures for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- E. Correct deficiencies and replace damaged or defective metering system components.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. Provide closeout submittals.
- B. Provide demonstration and training to Owner's representative.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of 1 hour of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.6 PROTECTION

- A. Protect installed system components from subsequent construction operations.

END OF SECTION 262713

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SECTION 262726
WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates and covers.
- E. Floor box service fittings.
- F. Poke-through assemblies.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 260583 - Wiring Connections: Cords and plugs for equipment.

1.3 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.

1.4 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 Resident Project Representative of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- 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. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFCI Receptacles: Include information on status indicators.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 Wiring Devices - General Requirements

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.
- B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.
- C. Prewired Wiring Device and Outlet Box Assemblies: Factory-assembled products complying with requirements for wiring devices, boxes, and wiring methods may be used in lieu of field-assembled products.
 - 1. Wiring: See Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
 - 2. Boxes: See Section 260533.16 - Boxes for Electrical Systems.
 - 3. Manufacturers:
 - a. Hubbell Incorporated.
 - b. Leviton Manufacturing Company, Inc.
 - c. Pass & Seymour, a brand of Legrand North America, Inc.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Wiring Device Applications:
 - 1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
 - 2. Receptacles Installed in Dwelling Units: Use tamper-resistant receptacles.
 - 3. Provide GFCI protection for:
 - a. Receptacles installed within 6 feet of sinks.
 - b. Receptacles installed in kitchens.

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- c. Receptacles serving electric drinking fountains.

E. Wiring Device Finishes:

- 1. Provide wiring device finishes as described below, unless otherwise indicated.
- 2. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- 3. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- 4. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- 5. Wiring Devices Installed in Wet or Damp Locations: White with weatherproof cover.

2.2 WALL SWITCHES

A. Manufacturers:

- 1. Hubbell Incorporated: www.hubbell.com/#sle.
- 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
- 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- 4. Substitutions: See Section 016000 - Product Requirements.

B. 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.

C. 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.

1. Products:

- a. Hubbell Incorporated; EdgeConnect Series: www.hubbell.com/#sle.
- b. Leviton Manufacturing Company, Inc.
- c. Pass & Seymour, a brand of Legrand North America, Inc.
- d. Substitutions: See Section 016000 - Product Requirements.

2.3 WALL DIMMERS

A. Manufacturers:

1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
2. nLight.
3. SensorSwitch.
4. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

2.4 RECEPTACLES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. 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.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying

with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

a. Products:

- 1) Hubbell Incorporated, www.hubbell.com/#sle.
- 2) Leviton Manufacturing Company, Inc.
- 3) Pass & Seymour, a brand of Legrand North America, Inc.

D. 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.

a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

a. Products:

- 1) Hubbell Incorporated: www.hubbell.com/#sle.
- 2) Leviton Manufacturing Company, Inc.
- 3) Pass & Seymour, a brand of Legrand North America, Inc.
- 4) Substitutions: See Section 016000 - Product Requirements.

3. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.

a. Products:

- 1) Hubbell Incorporated.
- 2) Leviton Manufacturing Company, Inc.
- 3) Pass & Seymour, a brand of Legrand North America, Inc.
- 4) Substitutions: See Section 016000 - Product Requirements.

E. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.5 Wall Plates and Covers

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Intermatic, Inc: www.intermatic.com/#sle.
3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
5. Substitutions: See Section 016000 - Product Requirements.
6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. 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.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.6 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.

C. Flush Floor Service Fittings:

1. Dual Service Flush Combination Outlets:

a. Cover: Rectangular.

b. Configuration:

1) Power: Two standard convenience duplex receptacle(s) with duplex flap opening(s).

2) Voice and Data Jacks: Provided by others.

2. Accessories:

a. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

3. Products:

a. Hubbell Incorporated: www.hubbell.com/#sle.

b. Substitutions: See Section 016000 - Product Requirements.

2.7 POKE-THROUGH ASSEMBLIES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Thomas & Betts Corporation: www.tnb.com/#sle.

3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

4. Substitutions: See Section 016000 - Product Requirements.

B. 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.

C. Flush Floor Service Fittings:

1. Dual Service Flush Combination Outlets:

a. Cover: Hinged door(s).

b. Configuration:

1) Power: Two standard convenience duplex receptacle(s).

2) Communications: As indicated.

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- 3) Voice and Data Jacks: Provided by others.
- 2. Dual Service Flush Furniture Feed:
 - a. Configuration:
 - 1) Power: One 3/4 inch threaded opening(s).
 - 2) Communications: Two 1/2 inch threaded opening(s).
- 3. Accessories:
 - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

PART 3 EXECUTION

3.1 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 branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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.

3.3 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 260533.16 as required for installation of wiring devices provided under this section.
- 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.
- 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. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - 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.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Engineer.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

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SECTION 262813
FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.2 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 262816.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.
4. Spare Fuse Cabinet Keys: Two.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- B. Littelfuse, Inc: www.littelfuse.com/#sle.
- C. Mersen: ep-us.mersen.com/#sle.
- D. Substitutions: See Section 016000 - Product Requirements.

2.2 APPLICATIONS

- A. Service Entrance:
 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
- B. Feeders:
 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
- C. General Purpose Branch Circuits: Class RK1, time-delay.
- D. Individual Motor Branch Circuits: Class RK1, time-delay.

2.3 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.

- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.

2.4 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet in convenient location in main electrical room unless otherwise indicated.
- D. Identify spare fuse cabinet in accordance with Section 260553.

END OF SECTION 262813

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SECTION 262816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262813 - Fuses.

1.3 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. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- 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 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 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 Resident Project Representative of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.7 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.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Substitutions: See Section 016000 - Product Requirements.

- E. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.2 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.
- 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 (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- J. 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 3R.
- K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- L. Heavy Duty Switches:
 - 1. Comply with NEMA BS 31047.

2. Conductor Terminations:
 - a. 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

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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 260529.
- 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 (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - 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 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.16

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SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.

1.2 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- B. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- D. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- G. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- H. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- J. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- L. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- M. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- N. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 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 Resident Project Representative of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
- C. 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.

- D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
- G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.7 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.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- 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. 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.

2.3 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.

2.4 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.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- D. Provide required support and attachment in accordance with Section 260529.

- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install accessories furnished with each luminaire.
- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Emergency Lighting Units:
- I. Exit Signs:

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - 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.

3.4 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.

3.5 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.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.

- C. Demonstration: Demonstrate proper operation of luminaires to Owner's Representative, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.7 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100

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SECTION 270529
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 Section Includes

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

1.2 Related Requirements

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 270533.13 - Conduit for Communications Systems: Additional support and attachment requirements for conduits.
- D. Section 271000 - Structured Cabling.

1.3 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; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- E. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- J. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.4 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 Project Manager 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 033000.

1.5 Submittals

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- C. 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.

1.6 Quality Assurance

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 Delivery, Storage, and Handling

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 Support and Attachment Components

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. TIA-569.
 - b. NFPA 70.
 - c. BICSI TDMM 15th Edition.
 - d. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications 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. 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. Conduit Supports: Straps and clamps suitable for conduit to be supported.

1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 3. Conduit Clamps: Bolted type unless otherwise indicated.
 4. Products:
 - a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - b. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- C. Noncontinuous Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
1. Manufacturers:
 - a. Eaton Corporation: www.eaton.com/#sle.
 - b. Panduit: www.panduit.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
 2. Applications:
 - a. Do not exceed 5 feet between cable supports.
 - b. Maximum Number of Cables per Cable Support:
 - 1) J-Hooks: 50, regardless of capacity.
 - c. Allowable Cable Types:
 - 1) J-Hooks: Category 3, Category 5e, and Category 6.
 3. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
 4. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
 - a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
 - b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
 - c. Provide multitiered J-hooks where required to support multiple cabling systems.
 - d. Color coding to be visible from below after installation.

- 5. Products:
 - a. Gripple, Inc; Fast Trak J-Hook: www.gripple.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- E. Metal Channel/Strut Framing Systems:
 - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 2. Comply with MFMA-4.
- F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch diameter.
 - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - e. Outlet Boxes: 1/4-inch diameter.
- G. Anchors and Fasteners:
 - 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.

- d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- 2. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 5. Hollow Masonry: Use toggle bolts.
 - 6. Hollow Stud Walls: Use toggle bolts.
 - 7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 8. Sheet Metal: Use sheet metal screws.
 - 9. Wood: Use wood screws.
 - 10. Plastic and lead anchors are not permitted.
 - 11. Powder-actuated fasteners are not permitted.
 - 12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.

PART 3 EXECUTION

3.1 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.

3.2 Installation

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1, AND BICSI TDMM 15.

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HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

- 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. 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.
 - H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 - I. Secure fasteners in accordance with manufacturer's recommended torque settings.
 - J. Remove temporary supports.
- 3.3 Field Quality Control
- A. See Section 014000 - 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 270529

SECTION 271000
STRUCTURED CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Communications system design requirements.
- B. Communications pathways.
- C. Copper cable and terminations.
- D. Communications equipment room fittings.
- E. Communications outlets.
- F. Communications grounding and bonding.
- G. Communications identification.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.
- E. Section 270529 - Hangers and Supports for Communications Systems.
- F. Section 270533.13 - Conduit for Communications Systems.

1.3 REFERENCE STANDARDS

- A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2024.
- E. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2018d, with Addenda (2020).

- F. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- G. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.
- H. TIA-607 - Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2024e.
- I. UL 444 - Communications Cables; Current Edition, Including All Revisions.
- J. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- K. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
- D. Evidence of qualifications for installer.
- E. Field Test Reports.
- F. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
 - 1. Record actual locations of outlet boxes and distribution frames.
 - 2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
 - 3. Identify distribution frames and equipment rooms by room number on drawings.
- G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:

1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
 2. Supervisors and installers factory certified by manufacturers of products to be installed.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Store products in manufacturer's unopened packaging until ready for installation.
 - B. Keep stored products clean and dry.
- 1.7 WARRANTY
- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
 - B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESIGN

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
 1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).
 2. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
 3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
 4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
- B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
 1. IT Room 008.
- C. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.2 PATHWAYS

- A. Conduit: See section 270533.13.
- B. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.3 COPPER CABLE AND TERMINATIONS

- A. Manufacturers:
 - 1. Belden: www.belden.com/#sle.
 - 2. CommScope: www.commscope.com/#sle.
- B. Copper Horizontal Cable:
 - 1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
 - 2. Cable Type - Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
 - 3. Cable Capacity: 4-pair.
 - 4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
 - 5. Exterior Playground Camera: OSP rated cable.
 - 6. Cable Jacket Color - Voice and Data Cable: Blue., AV: Yellow, Fire Protection: Red, Wireless: Gray, Future Use: White, Security: Green, Alarm: Black.
 - 7. Product(s):
 - a. Belden; DataConnect Category 6 UTP Cable; D6UR (riser)/D6UP (plenum): www.belden.com/#sle.
 - b. CommScope; SYSTIMAX Twisted Pair Cables; GigaSPEED XL Category 6 U/UTP Cable: www.commscope.com/#sle.
 - c. CommScope; Uniprise Twisted Pair Cables; CS34 Series Category 6 U/UTP Cable: www.commscope.com/#sle.

- C. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.
- D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
 - 1. Performance: 500 mating cycles.
 - 2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
 - 3. Product(s):
 - a. Belden; DataConnect Category 6 Modular Jack: www.belden.com/#sle.
 - b. CommScope; SYSTIMAX RJ45 Jacks; MGS400 Series Category 6 U/UTP Modular Jacks: www.commscope.com/#sle.
 - c. CommScope; Uniprise RJ45 Jacks; UNJ600 Series Category 6 U/UTP Modular Jacks: www.commscope.com/#sle.
- E. Copper Patch Cords:
 - 1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
 - 2. Patch Cords for Patch Panels:
 - a. Quantity: One for each pair of patch panel ports.
 - b. Length: 3 feet.
 - 3. Product(s):
 - a. CommScope; SYSTIMAX Category 6 U/UTP Patch Cords: www.commscope.com/#sle.
 - b. CommScope; Uniprise Category 6 U/UTP Patch Cords: www.commscope.com/#sle.

2.4 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

- A. Copper Cross-Connection Equipment:
 - 1. Manufacturers:
 - a. Belden: www.belden.com/#sle.
 - b. CommScope: www.commscope.com/#sle.

- c. Siemon Company: www.siemon.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- 2. Patch Panels for Copper Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
 - a. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
 - b. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
 - c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
 - d. Provide incoming cable strain relief and routing guides on back of panel.
- 3. Product(s):
 - a. Belden; REVConnect Patch Panels: www.belden.com/#sle.
 - b. Belden; KeyConnect Patch Panels: www.belden.com/#sle.
 - c. Belden; DataConnect Patch Panels: www.belden.com/#sle.
 - d. CommScope; SYSTIMAX Copper Panels; 360-IPR-1100-XX Series Patch Panels: www.commscope.com/#sle.
 - e. CommScope; Uniprise Copper Panels; UNP-XX-DM Series Patch Panels: www.commscope.com/#sle.
- B. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.
 - 1. Size: As indicated on drawings.
 - 2. Do not paint over UL label.
- C. Equipment Frames, Racks and Cabinets:
 - 1. Manufacturers:
 - a. Middle Atlantic .
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Component Racks: EIA/ECA-310 standard 19 inch wide.

3. Wall Mounted Cabinets: Front doors with locks, louvered side panels, top and bottom cable access, and ground lug.
4. Cabinets: Steel construction with corrosion resistant finish.
5. Locks: Keyed alike.
6. Products:
 - a. Middle Atlantic Products SR Series Pivoting Rack 96-045B/rev 11a/09-16-11.

D. Cable Management:

1. Manufacturers:
 - a. Belden: www.belden.com/#sle.
 - b. CommScope: www.commscope.com/#sle.
 - c. Siemon Company: www.siemon.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Product(s):
 - a. Belden; Belden Cable Runway: www.belden.com/#sle.
 - b. Belden; Belden BHH/BHV Series Horizontal/Vertical Managers: www.belden.com/#sle.
 - c. CommScope Cable Runway: www.commscope.com/#sle.
 - d. CommScope Horizontal/Vertical Cable Managers; HCM-SS-XX-XX/VCM-DS-XX-XX Series: www.commscope.com/#sle.

2.5 COMMUNICATIONS OUTLETS

A. Manufacturers:

1. Belden: www.belden.com/#sle.
2. CommScope: www.commscope.com/#sle.
3. Siemon Company: www.siemon.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Outlet Boxes: Comply with Section 260533.16.

1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
2. Minimum Size, Unless Otherwise Indicated:
 - a. Voice Only Outlets: 4 inch by 2 inch by 2-1/8 inch deep (100 by 50 by 54 mm) trade size.
 - b. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.

C. Wall Plates:

1. Comply with system design standards and UL 514C.
2. Accepts modular jacks/inserts.
3. Capacity:
4. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 262726.
5. Product(s):
 - a. Belden; KeyConnect Faceplates: www.belden.com/#sle.
 - b. CommScope Faceplates; M Series: www.commscope.com/#sle.

2.6 GROUNDING AND BONDING COMPONENTS

- A. Comply with TIA-607.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.
- C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

3.2 INSTALLATION OF PATHWAYS

A. Install pathways with the following minimum clearances:

1. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
2. 12 inches from power conduits and cables and panelboards.
3. 5 inches from fluorescent and high frequency lighting fixtures.
4. 6 inches from flues, hot water pipes, and steam pipes.

B. Outlet Boxes:

1. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of telecommunications outlets provided under this section.
 - a. Mounting Heights: Unless otherwise indicated, as follows:
 - 1) Telephone and Data Outlets: 18 inches above finished floor.
 - 2) Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches above finished floor to top of telephone.
 - 3) Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches above finished floor to top of telephone.
 - b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - c. Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
 - d. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
 - e. Locate outlet boxes so that wall plate does not span different building finishes.
 - f. Locate outlet boxes so that wall plate does not cross masonry joints.

3.3 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:

1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.

2. Do not over-cinch or crush cables.
 3. Do not exceed manufacturer's recommended cable pull tension.
 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
1. At Distribution Frames: 120 inches.
 2. At Outlets - Copper: 12 inches.
- C. Copper Cabling:
1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
 2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
 3. Use T568B wiring configuration.
- D. Wall-Mounted Racks and Enclosures:
1. Install to plywood backboards only, unless otherwise indicated.
 2. Mount so height of topmost panel does not exceed 78 inches above floor.
- E. Identification:
1. Use wire and cable markers to identify cables at each end.
 2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
 3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Comply with inspection and testing requirements of specified installation standards.
- C. Visual Inspection:
1. Inspect cable jackets for certification markings.
 2. Inspect cable terminations for color coded labels of proper type.

3. Inspect outlet plates and patch panels for complete labels.
- D. Testing - Copper Cabling and Associated Equipment:
1. Test operation of shorting bars in connection blocks.
- E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION 271000

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SECTION 282000
VIDEO SURVEILLANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Video surveillance system requirements.
- B. Video recording and viewing equipment.
- C. Cameras.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.13 - Conduit for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 271000 - Structured Cabling: Data cables for IP video surveillance system network connections.
- F. Section 283111 - Building Intrusion Detection: For interface with video surveillance system.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 303 - Standard for Installing Closed-Circuit Television (CCTV) Systems; 2025.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of cameras with structural members, ductwork, piping, equipment, luminaires, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

2. Coordinate the work with other installers to provide power for cameras and equipment at required locations.
3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meetings:

1. Conduct meeting with facility representative to review camera and equipment locations and camera field of view objectives.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include elevations and details of proposed equipment arrangements. Include system interconnection schematic diagrams. Include requirements for interface with other systems.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
- D. Design Data:
 1. Video storage capacity calculations.
- 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, installation, and operation of product.
- F. Manufacturer's detailed field testing procedures.
- G. Field quality control test reports.
- H. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.
- I. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- J. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. Applicable TIA/EIA standards.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 303.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Video Recording and Viewing Equipment and Software:
 - 1. Exacqvision.
- B. Cameras:
 - 1. Illustra.

2.2 VIDEO SURVEILLANCE SYSTEM

- A. Provide new video surveillance system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. System Description: IP system with connection to network (IP) cameras.
 - 1. Surge Protection:

- a. Provide surge protection for exterior cameras.
 - b. Provide equipment power surge protection where electrical distribution system surge protection is not provided.
 - C. Cameras Required:
 - 1. See article "CAMERAS" below for product descriptions.
 - D. Video Recording and Viewing Equipment Required:
 - 1. See article "VIDEO RECORDING AND VIEWING EQUIPMENT" below for product descriptions.
 - E. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - F. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.
- 2.3 Video Recording and Viewing Equipment and Software
- A. Provide video recording and viewing equipment compatible with cameras to be connected.
 - B. Network Video Recorders (NVRs):
 - 1. Supports connection of network (IP) cameras.
 - 2. Supports continuous and event-based recording.
 - 3. Network Video Recorder:
 - a. Products:
 - 1) Basis of Design: Exacqvision Model IP08 - 24T-2AW .
 - C. Software:
 - 1. Unless otherwise indicated, provide all software and licenses required for fully operational system.
 - D. Monitors:
 - 1. Unless otherwise indicated, monitors to be provided by Contractor as part of work of this section.
 - 2. Monitor:
 - a. Manufacturers:
 - 1) Basis of Design: Tautang 32" Video Monitor with Mounting Bracket.

2.4 CAMERAS

- A. Provide cameras and associated accessories suitable for operation under the service conditions at the installed location. Provide additional components (e.g. enclosures, heaters, blowers, etc.) as required.
- B. Where not factory-installed, provide additional components (e.g. lenses, mounting accessories, etc.) as necessary for complete installation.
- C. Network (IP) Cameras:
 - 1. Signal-to-Noise Ratio: Not less than 50 dB.
 - 2. Provide the following standard features:
 - a. Automatic electronic shutter.
 - b. Automatic gain control.
 - c. Automatic white balance.
 - d. Web-based interface for remote viewing and setup.
 - e. Password protected security access.
 - 3. Products:
 - a. Axis Communications P38 Series Network (IP) Fixed Dome 180 Degree Multisensor Panoramic Camera; www.axis.com/#sle.
 - b. Basis of Design: Illustra Model IFF08-D13-OIB4 - Illustra Flex Gen4 8MP/4k Minidome camera.

2.5 ACCESSORIES

- A. Camera Enclosures: Where not factory-installed, provide camera enclosures suitable for operation under service conditions at installed location.
- B. Camera Mounting Supports: Where not factory installed, provide mounting supports necessary for installation.
- C. Provide components as indicated or as required for connection of video surveillance system to devices and other systems indicated.
- D. Provide components as indicated or as required for system power and network connections.
- E. Provide cables as indicated or as required for connections between system components.

1. Data Cables for IP Network Connections: Unshielded twisted pair (UTP) complying with Section 271000.

F. Provide accessory racks/cabinets as indicated or as required for equipment mounting.

PART 3 EXECUTION

3.1 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 branch circuit wiring installation is completed, tested, and ready for connection to system where applicable.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install video surveillance system in accordance with NECA 1 (general workmanship) and NECA 303.
- B. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment in accordance with Section 260529.
- D. Wiring Method: Unless otherwise indicated, use wiring in conduit.
 1. Use suitable listed cables in wet locations, including underground raceways.
 2. Use suitable listed cables for vertical riser applications.
 3. Conduit: Comply with Section 260533.13.
- E. Provide grounding and bonding in accordance with Section 260526.
- F. Identify system wiring and components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Prepare and start system in accordance with manufacturer's instructions.
- C. Adjust cameras to provide desired field of view and produce suitable images under all service lighting conditions.

- D. Program system parameters according to requirements of Owner.
- E. Test for proper interface with other systems.
- F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.6 PROTECTION

- A. Protect installed system components from subsequent construction operations.

3.7 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 282000

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SECTION 283111
BUILDING INTRUSION DETECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Intrusion detection system requirements.
- B. Alarm control units and accessory equipment.
- C. Initiating devices.
- D. Alarm notification appliances.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260533.13 - Conduit for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 284600 - Fire Detection and Alarm.

1.3 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. UL 609 - Local Burglar Alarm Units and Systems; Current Edition, Including All Revisions.
- D. UL 634 - Connectors and Switches for Use with Burglar-Alarm Systems; Current Edition, Including All Revisions.
- E. UL 636 - Holdup Alarm Units and Systems; Current Edition, Including All Revisions.
- F. UL 639 - Intrusion-Detection Units; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of devices for the installed locations with work provided under other sections or by others.

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2. Coordinate the placement of sensors and keypads with millwork, furniture, equipment, etc. installed under other sections or by others.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install sensors and keypads until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
 1. Motion Detectors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include system interconnection schematic diagrams. Include requirements for interface with other systems.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- E. Manufacturer's detailed field testing procedures.
- F. Field quality control test reports.
- G. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
- H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- I. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Extra Fuses: Two for each type and size installed.

3. Extra Initiating Devices: One for each type installed.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 INTRUSION DETECTION SYSTEM REQUIREMENTS

- A. Provide new intrusion detection system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Alarm Control Unit: New addressable alarm control panel located as indicated.
- C. Keypads: Located as indicated.
- D. Initiating Device Requirements:
 1. Provide magnetic contacts to monitor opened/closed position for:
 - a. All perimeter doors and windows.
 2. Provide motion detectors to detect intruder in designated areas.
 3. Provide glass break detectors to monitor:
 4. Provide hold-up/panic button for:

- E. Alarm Notification and Reporting Requirements:
 - 1. Activate alarm notification at alarm control unit and associated keypads/annunciators with appropriate zone information displayed.
 - 2. Activate local notification appliances.
 - a. Interior: Provide siren located as indicated on drawings.
 - F. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 1. Local Alarm Units and Systems: Listed and labeled as complying with UL 609.
 - G. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.
- 2.2 Alarm Control Units and Accessory Equipment
- A. Manufacturers:
 - 1. Honeywell International, Inc; Honeywell Security: Basis of Design: Honeywell Vista 128FBPT Control Panel with Standby battery.
www.buildings.honeywell.com/#sle.
 - B. Alarm Control Panel: Modular construction.
 - 1. Enclosure: Lockable; provide tamper protection.
 - 2. Power Supply:
 - a. Primary Power: 120 VAC; provide suitable transformer/power supply; supervised for loss of AC power.
 - b. Secondary Power: Standby battery; provide suitable capacity for minimum standby time required by listing requirements, applicable codes, and authority having jurisdiction, but not less than four hours; provide suitable battery charger; supervised for low battery condition; protected from accidental reversal of battery leads.
 - C. Alarm Initiating Circuits: Supervised.
 - 1. Hardwired Zones: Supports both normally closed and normally open conventional (non-addressable) initiating devices.
 - 2. Addressable Zones: Supports addressable initiating devices and modules using multiplexed polling loops.
 - D. Alarm Notification Circuits: Supervised.
 - E. Communications Interfaces: Supervised.

1. Supports system reporting to central station receivers via integral interface or accessory interface modules using:
 - a. Telephone lines.
- F. Keypads: Supervised.
 1. Provide interface to alarm control unit for system control and remote annunciation.
 2. Provide visual notification of system status and zone information.
 3. Provide audible notification to indicate system status, entry/exit delay, and alarm situations; provide separate distinguishable sounds for alarm and trouble conditions.
 4. Keypad Type: Only LCD or graphic touch screen keypads are acceptable. Do not use LED keypads.
 - a. Graphic Touch Screen Keypads: Displays system status and zone information using plain English on graphic display; touch screen interface.
 - b. LCD Keypads: Displays system status and zone information using plain English on alphanumeric display; illuminated keys.
 5. Basis of Design: Honeywell 6160RF Premier Keypad
- G. Peripheral Devices: Supervised; provide tamper protection.
- H. Output Relays:
 1. Relay Modules: Form C relays (normally open and normally closed); provide tamper protection.
 2. Programmable to respond to system events, according to defined scheduling, or by manual activation from keypad.
- I. User Codes:
 1. Each user code to be individually assignable to any defined authority level for configurable access to system features and functions.
- J. Scheduling:
 1. Provide time/calendar-based scheduling capability for automated system control.
 2. Supports open/close schedules for control of arming/disarming and reporting.
 3. Supports timed events including, but not limited to:

- a. Point bypass/unbypass.
- b. Relay activate/deactivate.

K. Event Log:

- 1. Stores system events including time, date, partition, zone, and user code where applicable.
- 2. Supports viewing of event log on keypads.

2.3 INITIATING DEVICES

A. Manufacturers: Same as manufacturer of alarm control units where possible.

B. General Requirements:

- 1. Provide devices suitable for intended application and location to be installed.
- 2. Outdoor Units: Weather resistant, suitable for outdoor use.
- 3. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by control unit.
 - b. Provide suitable addressable modules for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

C. Contacts:

- 1. Listed and labeled as complying with UL 634.
- 2. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors or windows.
 - a. Use standard security contacts (not balanced magnetic type) unless otherwise indicated.
 - b. Use high security contacts (balanced magnetic type) for _____.
 - c. High Security Contacts: Balanced magnetic type; designed to activate upon attempts to defeat contact through external magnetic tampering.

3. Basis of Design Products:

D. Motion Detectors:

- 1. Listed and labeled as complying with UL 639.
- 2. Basis of Design Products:

E. Glass Break Detectors:

1. Listed and labeled as complying with UL 639.
2. Suitable for the glass type to be monitored.
3. Accurately discriminates false alarms from true glass break events.
4. Furnished with selectable sensitivity.
5. Basis of Design Products:

F. Hold-Up/Panic Switches:

1. Listed and labeled as complying with UL 634 or UL 636 as applicable.
2. Hold-Up/Panic Buttons: Manual push button operation.
3. Basis of Design Products:
 - a. Honeywell Wireless Panic Buttons.

2.4 ALARM NOTIFICATION APPLIANCES

- A. Manufacturers: Same as manufacturer of alarm control units where possible.
- B. Provide alarm notification appliances suitable for connection to control unit outputs.
- C. Outdoor Units: Weather resistant, suitable for outdoor use.
- D. Sirens: Speaker with self-contained siren driver.
 1. Provide tamper switches for outdoor units.
- E. Basis of Design Products:
 1. Honeywell Electronic Siren Wave 2.

2.5 ACCESSORIES

- A. Provide components as indicated or as required for connection of alarm control unit to devices and other systems indicated.
- B. Provide wireless receivers and repeaters as indicated or as required for communication between wireless devices and alarm control unit; provide tamper protection.
- C. Provide cables as indicated or as required for connections between system components.
- D. Provide end-of-line resistors (EOLR) as required for supervision of hardwired zones.

PART 3 EXECUTION

3.1 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 branch circuit wiring installation is completed, tested, and ready for connection to system.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Wiring Method: Unless otherwise indicated, use cables (not in conduit).
 - 1. Use listed plenum rated cables in spaces used for environmental air.
 - 2. Install wiring in conduit where required for rough-in, where required by authority having jurisdiction, and where exposed to damage.
 - 3. Conduit: Comply with Section 260533.13.
 - 4. Conceal all cables unless specifically indicated to be exposed.
 - 5. Route exposed cables parallel or perpendicular to building structural members and surfaces.
- D. Provide grounding and bonding in accordance with Section 260526.
- E. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- F. Identify system wiring and components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Prepare and start system in accordance with manufacturer's instructions.
- C. Inspection and testing to include, at a minimum:

1. Test each initiating device for proper response by alarm control unit.
 - a. Test glass break detectors using only manufacturer's recommended glass break simulation test units.
 2. Test for proper operation of alarm notification appliances.
 3. Test for proper operation of output relays.
 - D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
 - E. Submit detailed reports indicating inspection and testing results and corrective actions taken.
- 3.4 ADJUSTING
- A. Program system parameters according to requirements of Owner.
- 3.5 CLEANING
- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.
- 3.6 CLOSEOUT ACTIVITIES
- A. See Section 017800 - Closeout Submittals, for closeout submittals.
 - B. See Section 017900 - Demonstration and Training, for additional requirements.
 - C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
 - D. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of four hours of training.
 3. Instructor: Manufacturer's authorized representative.
 4. Location: At project site.
- 3.7 PROTECTION
- A. Protect installed system components from subsequent construction operations.

3.8 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 283111

SECTION 284600
FIRE DETECTION AND ALARM

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.
- B. Contractor shall review in detail all project drawings and specifications, construction material and methods, and other issues requiring coordination

1.2 Section Includes

- A. Fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.

1.3 Related Requirements

- A. Section 078400 - Firestopping.
- B. Section 087100 - Door Hardware:
 - 1. Electrically-operated locks and electromagnetic door holders for interface with fire alarm system.
- C. Section 142100 - Electric Traction Elevators: For interface with fire alarm system.
- D. Section 233300 - Air Duct Accessories: Smoke/fire dampers for interface with fire alarm system.
- E. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: For non-power-limited cables.
- F. Section 260526 - Grounding and Bonding for Electrical Systems.
- G. Section 260533.16 - Boxes for Electrical Systems.
- H. Section 260536 - Cable Trays for Electrical Systems.

1.4 Abbreviations and Acronyms

- A. AHJ: Authorities having jurisdiction.
- B. BAS: Building automation system.
- C. DMNS: Distributed mass notification system.

- D. ECS: Emergency communications system.
- E. EOL: End-of-line.
- F. EVACS: Emergency voice/audio communication systems.
- G. FACP: Fire alarm control panel.
- H. HVAC: Heating, ventilation, and air conditioning.
- I. IDC: Initiating device circuit.
- J. LAN: Local area network.
- K. MNS: Mass notification system.
- L. NAC: Notification appliance circuit.
- M. NPLFA: Non-power-limited fire alarm.
- N. PLFA: Power-limited fire alarm.
- O. SLC: Signaling line circuit.
- P. SOO: Sequence of operation.

1.5 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. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- D. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- G. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

- I. NECA 305 - Standard for Fire Alarm System Job Practices; 2018.
 - J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - K. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
 - L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
 - M. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - N. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.
 - O. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.
 - P. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.
 - Q. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.
 - R. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.
 - S. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.
 - T. UL 1638 - Standard for Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.
 - U. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.
- 1.6 Administrative Requirements
- A. Coordination:
 - 1. Coordinate arrangement of equipment with dimensions and clearance requirements of actual equipment.
 - 2. Coordinate placement of devices and notification appliances with potential conflicts or view obstructions.

3. Coordinate work to provide power for equipment at required locations (e.g., smoke dampers, type of actuators, line or local control transformer, zoning, grouping and circuit activations).
4. Coordinate requirements for branch circuit protection, identification, and shunt trip if applicable.
5. Coordinate reflected ceiling plans to avoid conflicting placements; maintain minimum diffuser and detector clearances as indicated.
6. Coordinate submittals to confirm equipment and associated components are capable of indicated settings, and manufacturer documentation identifies required compatible product listings.
7. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
8. Radio Transmitter: Coordinate roof location and installation with Architect.
9. Elevators or Escalators: See Division 14.

B. Preinstallation Meetings:

1. Conduct meeting with facility representative to review devices, notification appliances, and equipment locations.
2. Conduct meeting with facility representative and other related equipment manufacturers to discuss fire alarm system interface requirements.
3. Conduct meeting to review anticipated installation of code-required smoke control requirements, product solutions, and SOO.
4. Convene minimum of one week before starting work for review of documented SOO for system applications.

C. Sequencing:

1. Verify exact termination locations required for boxes, enclosures, and equipment.
2. Do not install devices or notification appliances until final surface finishes, painting, and cleaning are complete, unless otherwise required by AHJ.
3. Do not begin installation of conductors and cables until installation of conduit and pathways between termination points is complete.
4. Sequence work to protect cabling (e.g., overspray painting, physical stress, and insulation damage or covering markings).
5. Verify naming convention for equipment identification, including room names and numbers, prior to creation of final drawings, reports, and labels.

D. Scheduling:

1. Arrange access to facility for data collection with facility representative.
2. Where work involves interruption of existing electrical or fire alarm system service, arrange interruption with Owner.
 - a. Arrange test start and end with responsible reporting service. Confirm system normal operating mode and record as-found and as-left settings.
 - b. Arrange work to disable individual devices or circuits for minimal disruption if possible.
 - c. Arrange in accordance with NFPA 72 fire alarm system impairment requirements.
 - d. Where required by AHJ, arrange systems or partial system out of service interruption in accordance with requirements of building, life safety, and fire codes (e.g., approved fire watch plus required notifications, tags at each fire department connection and control valve, and AHJ notification when excess hours).

1.7 Submittals

- A. See Section 013000 - 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 FACP 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.
 9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 10. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified; include calculations demonstrating compliance with specified requirements, including spare capacity.
 11. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 12. Detailed drawing of graphic annunciators, displays, and interfaces.
 13. Certification by either FACP manufacturer or manufacturer of related equipment.
 14. Certification by FACP manufacturer that system design complies with Contract Documents.
 15. 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. Evidence of installer qualifications.
- H. Evidence of maintenance contractor qualifications, if different from installer.
- I. 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.
- J. Operating and Maintenance Data: 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.
- K. Project Record Documents: 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.

L. 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.

1.8 Quality Assurance

- A. Copies of Design Criteria Documents: For duration of project, maintain at project site copy of each referenced document that prescribes execution requirements; bound together. Also, NFPA 72, relevant portions of other applicable codes, and instructions and guidelines of AHJ. Include in submittals upon completion.
- B. Designer Qualifications: NICET Level IV (four) certified fire alarm technician or registered fire protection engineer, employed by FACP manufacturer, Contractor, or installer, with experience designing fire alarm systems in jurisdictional area of AHJ.
- C. Installer Qualifications: Firm with minimum three years documented experience installing fire alarm systems of specified type and providing contract maintenance service as regular part of their business.
1. Authorized representative of FACP manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 2. Installer Personnel: At least Level II (two) NICET with experience installing fire alarm systems.
 3. Supervisor: At least Level III (three) or Level IV (four) certified fire alarm technician; furnish name and address.
 4. Contract maintenance office located within 50 miles of project site.
 5. Certified in the State in which the Project is located as fire alarm installer.
- D. Manufacturer Qualifications: Company specialized in manufacturing products specified in this section with at least three years of documented experience.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1.9 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.
- D. Existing Conditions:
 - 1. Existing Fire Alarm System: Remove existing system completely after new system is fully operational and tested. Comply with NFPA 70.
 - a. Maintain existing under warranty as if new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected.
 - 2. Modifications to Existing System:
 - a. Remove inactive or abandoned cables and components from existing fire alarm system.
 - b. Remove accessible portion of abandoned cables unless tagged with identification product suitable to withstand conditions based on installed environment.

1.10 Warranty

- A. Fire Alarm Control Panels and Accessory Equipment: Provide minimum 1-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

2.1 Fire Alarm System

- A. General Requirements:
 - 1. Provide new addressable 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.
 - 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. Fire Alarm System Design Information:
 - a. Building Code: Comply with applicable building code.
 - 1) Principle Occupancy: As indicated on Architect code summary drawings.
 - 2) Principle Use: As indicated on Architect code summary drawings.
 - 3) Elevators: As indicated on Architect code summary drawings.
 - a) Type and Machine Room Information: Machine Room Less (MRL) Type.
 - 4) Occupant Evacuation Method: Total building.
 - b. NFPA 72 Fire Alarm System Classification: Protected premises.
 - c. Smoke and Heat Detector Coverage: Partial or selective coverage in accordance with NFPA 72.
 - d. Signal Priorities:
 - 1) See fire alarm system matrix indicated on drawings.

5. Provide fire alarm circuits in accordance with NFPA 70.
 - a. Comply with methods of interconnecting FACP's and remote annunciators 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 and NFPA 72.
 - c) Power-Limited Fire Alarm (PLFA) Circuits:
 - 1 Provide identification for PLFA circuits in accordance with NFPA 70.

6. 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 (daisy-chain loop, with isolation modules, minimum one per level).
 - b) IDCs: Class B (daisy-chain with EOL resistor device installed at end of circuit).
 - c) NACs: Class B (daisy-chain with EOL resistor device installed at end of circuit).
 - d) Other Wiring:
 - 1 Other life safety control features not covered above (e.g., door holder circuits, elevator recall circuits, fire smoke dampers, and air handling system interfaces), wired as Class D (failsafe, intended operation is performed in event of pathway failure).
 - 2 Where Class D wiring is not possible due to limitation of equipment, wiring limited to 3-feet between addressable control module and equipment and be installed in metallic conduit.
 - c. Pathway Survivability:
 - 1) Unless otherwise indicated or required, pathways to meet requirements for Pathway Survivability Level 0 (nonrated cable, no required provisions for pathway survivability).
7. Spare System Capacity:
 - a. SLCs: Minimum 25 percent spare capacity.
 - b. NACs: Minimum 25 percent spare capacity.
8. Secondary Power Source - Battery Storage Capacity:
 - a. Provide standby (nonalarm) operation sufficient for 24 hours.
 - b. Provide additional alarm operation for 5 minutes.

- c. Calculate combined of standby load plus alarm load for overall battery storage capacity requirements, per power supply.
 - d. Provide 25 percent additional overall battery capacity correction factor.
- B. Fire Alarm System Interfaces and Control Functions:
 - 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 initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with NFPA 72.
 - 4. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.
 - 5. Elevators:
 - a. Comply with ASME A17.1.
 - b. Elevator Shutoff:
 - 1) Elevator Machine Room/Space Heat / Smoke Detector:
 - a) Shut down elevator power prior to hoistway.
 - b) Locate within 24 inches of each sprinkler in accordance with NFPA 72.
 - 2) Sprinkler Pressure or Waterflow: Shut down elevator power prior to hoistway sprinkler activation.
 - 3) For each elevator, provide output signal to stop elevator via addressable relay module and power isolation relay.
 - c. Elevator Emergency Recall Operation:
 - 1) Elevator Lobby, Hoistway, and Machine Room/Space Smoke / Heat Detectors: Elevator recall for fire fighters' service.
 - 2) In each elevator machine room/space, provide interface for each elevator car or group of elevator cars as determined by AHJ via separate addressable relay modules for each output signal below, where applicable.
 - a) Recall elevator to designated (primary) level.
 - b) Recall elevator to alternate level.

- c) Smoke detection in elevator machine room/space (fire fighter's hat light).

6. Electrically Locked Doors:

- a. Comply with NFPA 72, building code, and life safety code requirements for electrically locked doors.
- b. Door Release:
 - 1) Provide output signal for release of electrically locked doors via addressable relay module and power isolation relay.
 - 2) Provide connection to UL 864 listed control system interface or interface with door control power where interruption of control power releases doors.
 - 3) Activate door release by building fire alarm event and in accordance with NFPA 72.
 - a) Building Occupancy or Application-Based Exceptions:
_____.
 - b) Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from.
 - c) Building Occupancy or Application-Based Exceptions:
_____.
- c. Lock Power Supplies: Provide independent power supplies.

7. HVAC Systems:

- a. Energy Recovery Units (ERUs):
 - 1) Provide duct smoke detector on supply side of air stream.
 - 2) Provide duct smoke detector on return side of air stream.
 - 3) Provide remote test station for each duct smoke detector unless explicitly indicated as not required.
 - 4) Provide output signal to shut down units with at least one duct smoke detector via addressable relay module.
 - 5) Where fire/smoke dampers are located downstream of unit, provide monitoring point input to determine that unit is not operational and subsequently provide output signal to close such dampers via addressable relay module and power isolation relay.

- b. Remote Test Stations: Provide remote test station for each duct smoke detector unless explicitly indicated as not required. Unless otherwise indicated, use remote test stations only in clean, dry, indoor, nonhazardous locations.

2.2 Fire Alarm Control Units and Related Equipment

A. Manufacturers:

- 1. Honeywell International, Inc: Silent Knight SK6820XL or approved equal.
- 2. Source Limitations: Furnish FACP and related equipment produced by single manufacturer and obtained from single supplier.
- 3. Description: Control panel shall be field-programmable, microprocessor-based, modular, power-limited design with electronic modules.

B. Fire Alarm Control Panels and Related Equipment: Listed and labeled as complying with NFPA 72 and UL 864.

1. General Characteristics:

- a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
- b. Database (site specific software) is the property of City of Philadelphia and/or as designated. Passwords shall NOT be placed on the panel software to restrict access to SEPTA for future modifications.
- c. Include real-time clock for time annotation of events on event recorder and printer.
- d. Provide communication between FACP and remote circuit interface panels, annunciators, and displays.
- e. FACP must be listed for connection to remote station signaling system service.
- f. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACP must provide minimum 500-event history log.
- g. Addressable Initiation Device Circuits: FACP must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.

- 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACP must be listed for releasing service.
- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, minimum three line(s) of 80 characters, minimum or as compatible with FACP.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- C. Provide cabinets and enclosures as indicated or as required to house system components.
 1. The fire alarm panel shall utilize a substantially large panel to control the system. Spare points, equal to 25% of the total points of each SLC Loop, must be provided.
- D. Seismic Qualification: Provide fire alarm system and associated components suitable for application under project seismic design criteria where required. Include certification of compliance with submittals.
- E. Fire Alarm Control Panel (FACP): Addressable.
 1. SLCs and IDCs: Configurable for Class B or Class A with additional modules.
 - a. System Minimum SLC Capacity: 500 device addresses.
 - b. FACP shall include capability for up to three (3) Silent Knight Model 5815XL Loop Expanders.
 - c. The SLC loops shall be thoughtfully divided through the building (floor levels). Project Manager must approve SLC distribution prior to construction.
 - d. All programmed device point descriptions must be approved by Project Manager.
 2. The FACP shall not have any penetration through the top of the cabinet.
 3. NACs: Integral and programmable with synchronization modules or cards as required.
 4. Power Supply: 120 VAC, 60 Hz, supplying necessary power for FACP.

- a. Contractor shall provide dedicated 120 VAC power to the new fire alarm system main panel and any other panel or devices as required to complete the system. (NOTE: The 120VAC power connected to the existing fire alarm system may be re-used to power the new fire alarm panel.)
5. The control panel shall include a communication device for monitoring that is programmable by any reputable contractor regularly engaged in the Fire Alarm installation, maintenance, and monitoring business.
6. Support self-testing detector capability.
7. Remote Annunciator Support: Up to eight (8).
8. Provide NAC expansion as required.
 - a. If a remote power module is required, it shall be a Silent Knight 5895XL or approved equal of the same manufacturer as the Main FACP.
9. Enclosure Finish Color: Red.
- F. Notification Appliance Circuit Expansion:
 1. Where notification appliance circuit requirements exceed capacity of FACP, provide accessories and cabinets as required for expansion.
- G. Manual Fire Alarm Pull Stations:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 2. Silent Knight; Honeywell International, Inc.
 3. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
 - a. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box.
 - b. If indicated as surface mounted, provide manufacturer's surface back box.
 - c. Able to perform at up to 90 percent relative humidity at 90 deg F.
 4. Fire alarm pull stations shall be Silent Knight Model SK-PULL -DA with a SB-I/O Surface Mounted back box or approved equal as required.
 5. Fire alarm pull stations shall be dual-action and ADA Compliant.
 6. Pull stations shall be mounted at be mounted at ADA compliant height of 48 inches from the finished floor height to the center of activation handle.

7. Fire alarm pull stations must be equipped with a CAT30 system lock prior to installation. NOTE: Contractor shall provide and install the CAT30 lock cylinders. Fire alarm pull stations that require glass breakage or that have crushable tubes to activate are not acceptable.
8. Pull station final mounting locations shall be determined in the field with concurrence from the Project Manager. Unless a pull station final location has been agreed to with the Project Manager it can be subject to relocation at no cost.
 - a. Station Reset: Key-operated switch.

H. Addressable Interface Modules:

1. General Requirements:
 - a. Provide addressable modules suitable for connection to FACP SLCs.
 - b. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.
2. Addressable Monitor Modules: Unless devices are explicitly permitted connected together on one zone; provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable FACP.
 - a. Monitoring Modules shall be Silent Knight SK-MONITOR or approved equivalent. If multiple Modules are required a Silent Knight Model SK-MONITOR-2 or Model SK-MON-10 or approved equivalent may be used. Model SK-MON-10 shall be mounted in a Silent Knight IDP-ACB-SK Module Cabinet or approved equivalent.
 - b. Monitoring Modules used for elevator recall must be mounted in the elevator machine room/space.
 - c. Monitoring modules must be accessible from ground level and installed in conditioned spaces unless directed otherwise.
 - d. SK -MINIMON must be installed in a separate junction boxes.
3. Addressable Relay and Control Modules: Provide as indicated or as required for selective control of notification appliances.
 - a. Relay Module shall be Silent Knight Model SK-RELAY or approved equivalent. If multiple relays are required, Silent Knight Model SK-RELAY-2, Model SK-RELAY-6 or SEPTA approved equivalent may be used.
 - b. Fire Alarm System Output relay modules shall be used to control the shutdown and/or operational inputs to supplemental equipment (i.e., elevators or HVAC systems).

- c. Relay Module shall be UL Listed, and FM approved with the main FACP.
 - d. SK-RELAY Module shall be mounted in a 4-inch square box within three (3) feet of the connected equipment. SK-RELAY-6 shall be mounted in a Silent Knight IDP-ACB- SK Module Cabinet or approved equivalent.
 - e. Control Modules shall be Silent Knight SK-CONTROL Module or approved equivalent and shall be mounted in a 4-inch square box within (3) feet of the connected equipment. If multiple control relays are required, SK-CONTROL-6 may be used and mounted in a Silent Knight IDP-ACB- SK Module Cabinet or approved equivalent.
 - f. Fire alarm contractor shall provide and install all conduit and wiring from the output relay module to the connected equipment.
 - g. Output & Control Relay Modules must be accessible from ground level and installed in conditioned spaces unless directed otherwise.
 - h. Fire Alarm contractor shall make final termination to the connected equipment.
4. Addressable Isolation Modules:
- a. Provide as indicated or as required to perform necessary functions.

2.3 SYSTEM SMOKE DETECTORS

- A. Detectors shall be installed so that they can be safely and easily accessible by ladder or lift.
- B. Detectors shall not be installed in locations that make it difficult or impossible to comply with periodic inspection and cleaning requirements. This requires careful consideration of space for ladder or lift movement, positioning, and installation. Use of an extension ladder requires a safe anchor point for the ladder. Further, pipes, air vents, ducts, etc. should be considered for their impact on Fire Alarm Device accessibility. Detectors in stairways should be positioned to allow safe access by ladder. The provision for accessibility may require additional detectors, such as in a small room where duct work is placed in the center of the room.
- C. Where a ladder or lift will not be feasible, the design must include an installed ladder, platform, catwalk, or other method of accessing the detector.
- D. Detectors shall be installed in information and/or communication equipment rooms, mechanical rooms, electrical rooms and within the vicinity of any electrical transformer equipment, electrical vacuum switches, or other high voltage electrical equipment. In general, detectors should be placed over the aisles in areas containing this type of equipment.
- E. In all cases, the selection and mounting location of detectors shall be influenced by the ease of maintenance to include sensitivity testing.

- F. Smoke detectors shall be Silent Knight Model SK-PHOTO or SEPTA approved equivalent.
 - G. The selection and placement of smoke detectors shall consider both the performance characteristics of the detector and the areas into which the detectors are to be installed to prevent nuisance alarms or improper operation after installation. The Contractor shall consult with the Project Manager regarding any potentially questionable device locations.
 - H. The smoke detectors shall be provided with dust covers, which could be used as temporary covers when workmen are working in an area. These covers must be turned over to the Project Manager upon turnover of the system.
 - I. Smoke detectors shall have a visual indicator to indicate the status of the detector.
 - J. Heat detectors shall be Silent Knight Model SK-HEAT or approved equivalent.
 - K. Heat detectors used in unconditioned spaces, and elevator shafts shall be Potter Thermotech 302-ET-135 or approved equivalent and be mounted on an waterproof cast metal back box and cover or approved equivalent.
 - L. Fixed temperature heat sensors should be considered in areas where the temperature fluctuations are common, i.e., kitchens, garages, attics, heater rooms, small rooms with wall mounted electric heaters.
 - M. Rate-of-Rise heat sensors should be considered in areas where the temperature is consistent, i.e., storage rooms, electrical rooms, maintenance areas, workshops, etc.
 - N. Detectors are required in any electrical substation areas and/or electrical distribution area and above branch circuit breaker panels.
 - O. If the installation is in an area that requires an explosion proof system, the installation should be in accordance with NFPA 69.
 - P. All heat detectors must be testable.
 - Q. No devices shall be installed until all construction activity has been completed or approved by SEPTA Fire Systems Manager.
 - R. All devices cannot be installed directly over any equipment and must be able to be serviced without reaching of a ladder or lift.
- 2.4 DUCT SMOKE DETECTORS
- A. If a Duct Smoke Detector is not integrated into the HVAC unit by the manufacturer, the Duct detector shall be Silent Knight Model SK-DUCT, or approved equivalent.
 - B. Each Duct Detector must include an RTS-151KEY Test Switch, or approved equivalent.

- C. Duct smoke detectors shall be provided and installed where shown on contract drawings by the Fire Alarm contractor on any HVAC air handler and/or make up air handler.
- D. Duct detector housings shall be UL listed with the respective smoke detector.
- E. Keyed test switches must be installed for all duct detectors and accessible from the ground level.
- F. Contractor is responsible for designing, installing, and submitting for approval all components and methods of accomplishing HVAC and/or make-up air handler shutdowns.
- G. Contractor shall provide and install all parts and material required to perform the shutdown of the air handler unit(s) and/or actuation of any smoke evacuation fans.
- H. Contractor shall provide independent power supply to each duct detector. Power cannot be taken from the air handling unit.
- I. Duct Detector must be easily and safely accessed by ladder or scissor lift, so it can be cleaned, replaced, or tested when needed. Any Duct Detectors installed that cannot be accessed safely as noted above will require the Contractor to install an OSHA approved catwalk or platform at the Contractors expense.

2.5 BEAM SMOKE DETECTORS

- A. If required, Beam Smoke Detectors shall be Silent Knight Model SK-BEAM-T, or approved equivalent.
 - 1. Beam Detector must be mounted on a factory approved bracket.
- B. If the Beam Detector range exceeds 230', the Contractor shall install a Silent Knight Model BEAMLRK, or approved equivalent.
- C. Heater kits shall be installed on both Transmitter/Receiver and Reflector on all detectors as required. Silent Knight Model BEAMHK and Silent Knight Model BEAMHKR or approved equivalent. Contractor shall be responsible for providing power to each unit.
- D. Remote Test switches shall be installed for each beam detector. Remote Test Switch shall be Silent Knight Model RTS-151KEY.
- E. Contractor must provide an OSHA approved ladder to access each beam detector to facilitate regular service and cleaning.

2.6 AIR-SAMPLING (VESDA) SMOKE DETECTORS

- A. The VESDA-E VEU is a highly advanced aspirating smoke detection system designed for early warning of fire conditions.

1. Key specifications include:
 - a. Alarm Sensitivity: Ultra-wide alarm sensitivity range from 0.001% - 20.0% obs/m (0.0003 to 6.25% obs/ft).
 - b. Area Coverage: Up to 6,500 m² (69,965 sq. ft) with a detection range of 400 m (1,312 ft).
 - c. Integration: Compatible with Johnson Controls Inc. addressable fire detection units for remote monitoring and control.
 - d. Advanced Features: Utilizes CMOS imaging, multi-directional light scattering, and sophisticated algorithms for smoke detection.

2.7 Fire Alarm System Cabinet, Power, Raceway, Wiring, and Labeling

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: Not 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.

D. All Fire Alarm wiring must be installed in conduit.

E. Proposed SLC circuits must be reviewed and approved by the Project Manager before any wire is pulled.

F. Penetrations are not allowed into the top of any cabinets and factory panels. Penetrations into the side of the cabinets and panels must use weatherproof fittings.

G. Conduit shall be mounted above any room or area with a suspended ceiling.

- H. Design must provide for the complete labeling of the raceway as "FIRE ALARM". White label with red text must be waterproof (peel-off type). These labels shall be placed on every connection box. Connection box labels should measure 3"x 3". Conduit shall be labeled a minimum of every 20 feet; shorter lengths of conduit between connection boxes should be labeled at the midway point. Conduit labels shall be rectangular shaped and measure ¾" wide by 5 ½" long. The raceway shall be installed in a manner that considers the effects of electrical and Radio Frequency noise to prevent electromagnetic interference.
- I. Conduits and/or wiring shall not be installed less than 12-inches from any conduit or exposed electrical bus work and/or distribution panel containing 480Volt or higher voltage electrical conductors.
- J. Gasketed Weather-Proof Cast Electrical Boxes (not 1900 Style or octagon sheet metal boxes) shall be Bell Model# 5372-0 or approved equivalent for ceiling devices with detector deflector plate shall be used for surface mounting any device(s) to any exposed ceiling surface or support beam (i.e., in the ceiling, electrical substations, mechanical rooms, etc.). All devices located outside or in unconditioned spaces or subject to washdown or has the potential of getting wet from any source shall be waterproof.
- K. Fire Alarm devices installed on the ceiling of rooms located underground must install a drip plate between the weather-proof cast backbox and the fire alarm device. SEPTA Fire Systems Manager shall provide the contractor drip plates for all required devices.
- L. Standard sheet metal (1900 Style) back boxes shall be permitted for use on non-surface mounted devices.
- M. Existing conduits and/or suspended ceiling support systems cannot be used to mount new conduits or device back boxes.
- N. The distance between connection (junction) boxes for the Fire Alarm system should not exceed 100 feet.
- O. The Fire Alarm conduit shall be a minimum of ¾" EMT with set screw type connectors. Conduit shall not exceed (4) FPLR 2-wire cables. ¾" flexible type (Greenfield) conduit may be used when dropping into notification or initiating devices. ¾" conduit shall not exceed four (4) FPLR 2-wire cables. Non-fire alarm cable shall not be installed in any fire alarm conduit.
- P. Greenfield type flexible conduit can be used only above suspended ceiling and/or within walls and shall be 100% concealed from eyesight during normal operating conditions and shall be a minimum of ¾" and shall not exceed 10-feet. (NOTE: must be metal lined type).
- Q. Any/all penetration into the buildings shall be properly and professionally sealed to prevent water/weather infiltration into the buildings.
- R. The Fire Alarm System notification circuit shall be a minimum of FPLR 14 gauge; the initiating circuit shall be a minimum of FPLR 16 gauge.

- S. Conductors and Wiring material and methods shall meet all NFPA, NEC and local code requirements.
- T. Wires installed in FACP, Power Supply cabinets, and NEMA 4X cabinets must be run in a neat, straight right angle, and secured in a professional manner.
- U. Splices and wire nuts are NOT allowed anywhere in the system.
- V. All wires for initiation and notification devices shall be labeled at each junction point throughout the system. The label shall indicate "IN" or "OUT" along with the programmed device number (e.g., IN 97.4, OUT 97.5, IN CP-C1-D2) to allow circuit identification at terminal and junction locations. Circuit identification labels must be of high quality and equal to the Brady Label Printer.
- W. If the installation is in an area that requires an explosion proof system, the installation should be in accordance with NFPA 69.
- X. Ground Fire Alarm Control Panel and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to FACP. Ground shielded cables at the FACP only, Insulate shield at device location.

PART 3 EXECUTION

3.1 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.
 - 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.

3.2 Installation

- A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:
 - 1. Manufacturer's instructions, applicable codes, and Contract Documents.
- 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.
 - a. Minimum conduit size: 3/4".
 - 3. Install firestopping to preserve fire resistance rating of partitions and other elements.
 - 4. Provide required vibration isolation or seismic controls.
- 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 260526.
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.
 - 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 260553.

2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
3. Post laminated final SOO and system drawings at FACU.
4. Mark location of disconnecting means for NPFLA circuits.
5. Coordinate to provide red branch power circuit protective devices or identify them accordingly as required by NFPA 72 and NFPA 70.
6. 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, FACP 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. Confirm integrated fire protection and life safety system tests are in accordance with:
 - a. Fire Code: ICC (IFC).

3.3 Field Quality Control

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide services of manufacturer's authorized representation to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's detailed testing procedures and field reports and with submittals.
- C. Provide equipment, two-way radios for testing personnel use, tools, and supplies required to accomplish inspection and testing.
- D. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.
- E. Inspect and test in accordance with manufacturer's instructions.

- F. Inspect wiring and components for damage and defects.
 - G. Batteries and Power Supplies: Perform inspections and tests listed in manufacturer installation instructions.
 - H. Perform additional requirements related to testing and inspection during system startup.
 - I. Test for interface with other systems.
 - J. Test shunt trips to verify operation.
 - K. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.
 - L. Submit detailed reports indicated inspection and testing results, corrective actions taken, and as-found and final adjusted settings.
- 3.4 System Startup
- A. Obtain Owner approval prior to performing system startup.
 - B. Manufacturer Services: Provide services of manufacturer's authorized representation to systems startup. Include manufacturer's detailed startup procedures with submittals.
 - C. Prepare and start equipment and systems in accordance with manufacturer's instructions and recommendations.
- 3.5 Adjusting
- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
 - B. Adjust initiating device and notification appliance settings to achieve desired operation as indicated in submittals.
 - C. Measure power supply primary and secondary voltages, log values for records, and make appropriate adjustments.
 - D. Adjust alignment of equipment covers and doors. Provide keys and spare keys to Owner.
 - E. Reprint and reinstall damaged or misinstalled labels; maintain neat and square to installed location good workmanship - see NECA 1; maintain consistent placements for identification on products of similar type.
 - F. Adjust devices or notification appliances and associated bases to be flush and level.
 - G. Program system parameters according to requirements of Owner.

3.6 Cleaning

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. See Section 017419 - Construction Waste Management and Disposal for field-generated construction waste requirements.
- C. Check tightness of electrical connections. Replace damaged components and provide closure plates for vacant positions. Provide circuit directory updates for related power branch circuits.
- D. Clean and repair existing materials and equipment that remain or are indicated for reuse.
- E. Clean dirt, debris, plaster, and other foreign materials from outlet boxes and fire alarm system equipment and components.
- F. Clean fire alarm system equipment and components according to manufacturer's instructions and NECA 305.
- G. Clean surfaces and interiors of boxes and device cover plates in accordance with manufacturer's instructions to remove dirt, fingerprints, debris, plaster, and other foreign materials.
- H. Repair scratched or marred exposed surfaces to match original factory finish.
- I. Comply with federal (EPA), state, and local regulations for battery handling and disposal. Do not spill battery fluids down plumbing drains. Only use containers safe for transportation marked 'nonspillable.'

3.7 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.
- 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.

3.8 Owner Personnel Instruction

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
 - 3. Factory Instruction: At FACU manufacturer's authorized training facility.
- B. Administrative: One-hour session(s) covering issues necessary for nontechnical administrative staff; classroom:
 - 1. Initial Training: Minimum one-hour session precloseout.
- C. Basic Operation: Minimum one-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: One session precloseout.
- D. Detailed Operation: Minimum two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
 - 1. Initial Training: One session precloseout.
- E. Maintenance Technicians: Detailed training for electrical technicians on programming, maintaining, repairing, and modifying; factory training:
 - 1. Initial Training: Minimum one-hour session, post-occupancy.
- F. Use operation and maintenance documentation as primary instruction material; have paper copies available for attendees and supplement training material aids.

3.9 Closeout Activities

- A. See Section 017800 - Closeout Submittals for additional submittals.
- B. See Section 017900 - 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 FACP 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.
- D. Occupancy will not occur prior to Substantial Completion.
- E. Substantial Completion of project cannot be achieved until inspection and testing is successful and the following:
1. Approved operating and maintenance data has been delivered.
 2. All aspects of operation have been demonstrated to Owner.
 3. Final acceptance of fire alarm system has been given by AHJ.
 4. Specified precloseout instruction is complete.
- F. Perform post-occupancy instruction within three months after Substantial Completion.

END OF SECTION

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SECTION 310000 – EARTHWORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work under this Section shall include all labor, material, equipment and all else necessary for cutting, proof rolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract. Work under this Section includes, but is not limited to, subgrade preparation, excavating, backfilling, and compaction for structures and foundations, pavements, sidewalks, landscaping areas, and utilities.
- B. The Contractor shall retain and pay for an independent geotechnical testing agency to perform field testing and inspection required by this Section.
 - 1. The testing agency and laboratory shall be subject to review and approval by the Owner and Engineer prior to the start of work.
 - 2. The testing agency shall meet the requirements of ASTM D3740 and shall have demonstrated experience performing earthwork testing and inspection services.
 - 3. The Contractor shall coordinate testing and inspection services with construction activities and provide access to the work as required.
- C. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.
- D. Undertake any special construction procedures for the project as shown in the drawings and described by these specifications for preparation of pavement areas.
- E. The Contractor shall be responsible for the methods, equipment, and sequencing necessary to excavate materials encountered and complete the work in accordance with the Contract Documents.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM), latest edition
 - 1. C 33 Concrete Aggregates
 - 2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort
 - 3. D 1556 Density and Unit Weight of Soils in Place by the Sand-Cone Method
 - 4. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 5. D 2167 Density and Unit Weight of Soil in Place by Rubber Balloon Method
 - 6. D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 - 7. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - 8. D 2937 Density of Soil in Place by the Drive-Cylinder Method
 - 9. D 3740 Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - 10. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

11. D 4254 Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
 12. D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- B. American Association of State Highway and Transportation Officials (AASHTO), latest edition
1. T 88 Particle Size Analysis of Soils
- C. Associated General Contractors of America
1. Manual of Accident Prevention in Construction
- D. Philadelphia Parks & Recreation (PPR) Division 31 Outline Specifications – Earthwork, Section 310000.

1.4 QUALITY ASSURANCE

- A. A qualified geotechnical testing agency retained by the Contractor shall perform field observation and testing of earthwork operations in accordance with this specification. This inspection will not relieve the Contractor from their responsibility to complete the work in accordance with the drawings and specifications. Observation, testing, or inspection by the Engineer or testing agency does not constitute acceptance of the work and does not relieve the Contractor of responsibility for compliance with the Contract Documents.
- B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the testing agency as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.
- C. The testing agency shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner, engineer, and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.
- D. All costs related to reinspection due to failures shall be paid for by the Contractor at no additional expense to Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

1.5 SUBMITTALS

- A. Testing Agency Qualifications: Provide a statement of qualifications of the geotechnical testing agency that will perform the quality control tasks required in Article 3.08.
1. The geotechnical testing agency shall be an experienced inspector working under the direction of the professional engineer licensed to practice in the Commonwealth of Pennsylvania who is experienced in providing engineering services related to earthwork.
 2. The testing agency shall be an independent laboratory having a minimum of three (3) years' experience in conducting the testing indicated herein.
 3. The testing laboratory shall meet the requirements of ASTM D 3740.
- B. Material Test Reports: Shall be provided from the testing agency indicating and interpreting test results for compliance on the following:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D1557 or D698 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.
 3. Material Gradation Tests.

- 4. Electrical Resistivity and pH tests for sand used for water pipe bedding and backfill.
- C. Within 10 days after award of the contract, the Contractor shall submit to the Owner and engineer a schedule detailing the sequence, and time of completion of all phases of work under this section.
- D. At least two weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the engineer of record for each type of imported soil/gravel material to be used as compacted fill.
 - 1. Moisture and Density Relationship: ASTM D1557;
 - 2. Particle-Size Analysis: ASTM D2487; and,
 - 3. Plasticity Index: ASTM D 4318.
- E. Together with the above test data, the Contractor shall submit a 25-pound sample of each type of off site fill material in an air tight container for the approval of the engineer of record.
- F. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the engineer.
- G. Geotechnical Testing and Environmental Due Diligence Reports: Submit geotechnical testing reports and environmental due diligence reports to the owner for review and for record prior to construction.
- H. Subgrade Compaction Test Reports and Field Logs: Submit to PPR for review and for record.

1.6 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Base Course: Layer placed between the subgrade and paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Approved soil materials imported from off-site for use as fill or backfill.
- E. Classification: No consideration will be given to the nature of earthen materials, and all excavation required for this Project will be designated as unclassified. Unclassified excavation includes all materials encountered regardless of type, including but not limited to soil, rock, boulders, urban fill, construction debris, abandoned foundations, pavements, and buried structures. No additional compensation will be provided due to the nature, hardness, or difficulty of materials encountered during excavation.
- F. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.
- G. Excavation: Removal of material encountered down to subgrade elevations:
 - 1. Bulk Excavation: Excavation more than 10 feet in width.
 - 2. Overexcavation: Excavation of existing unsuitable material beyond limits shown on the Drawings for replacement with structural fill as directed by the Owner.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond limits shown on the Drawings without direction by the Owner.

- H. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of “rock” but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.
- I. Rock:
 - 1. General Excavation - Any material that cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more; and,
 - 2. Trench Excavation - Any material that cannot be excavated with a backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.
- K. Subbase: Material shown on the Drawings between the pavement base and subgrade.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.7 REGULATORY COMPLIANCE

- A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended. Excavation and trenching are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.
- B. Conform with Pennsylvania Act 287 and all amendments and other applicable regulations regarding notification of utility companies.
- C. Any pumped water shall be discharged from the Site in accordance with federal, state and local codes and regulations. Comply with all Philadelphia Water Department permit requirements.
- D. Any soil materials leaving the site or being brought to the site shall comply with the Pennsylvania Department of Environmental Protection requirements for fill management.

1.8 PROJECT CONDITIONS

- A. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 3 days prior to excavation.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify the Owner not less than 72 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without the Owner's written permission.
- C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

- D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor's operation.
- E. Site Investigation: The Contractor acknowledges that they have visited the site, reviewed available subsurface information and contract documents, and satisfied themselves as to the conditions affecting the work prior to submitting a bid.

1.9 PPR GRADING AND EARTHWORK STANDARDS

- A. Provide positive drainage away from all structures.
- B. Unless otherwise noted on the Drawings, minimum slope for non-paved surfaces shall be ¼ inch per foot (2%) and maximum slope shall not exceed 3:1 (horizontal:vertical) (33%). Paved surfaces shall have a minimum grade of 1% and shall drain positively off of the pavement.
- C. Grades on designated accessible routes and areas shall comply with the Americans with Disabilities Act (ADA) and applicable accessibility standards.
- D. Notify PPR immediately if slope requirements cannot be met. Slopes in excess of the maximum specified above will not be accepted unless prior written approval is received from PPR.
- E. Grade earthen, non-paved surfaces to a smooth finish. Slope lawn areas in swales to a gentle crown along the centerline.
- F. Grade all seeded fine lawn areas flush with finish grade. Adjust finished grade to the proper depth where sod abuts paved areas.
- G. Grade all tree, shrub, and groundcover planting beds to 3 inches below the top of abutting curbs, paving, or lawn areas to allow for mulching.
- H. Adjust existing and new manhole, catch basin, and drain rim/grate elevations to match new grade elevations (pavement or soil) as applicable.
- I. Finished surfaces shall be graded smooth and even with no abrupt or awkward changes in grade.
- J. Provide properly compacted subgrades of native soil or approved fill. Native soils, fill, or subgrades deemed insufficient shall be removed and replaced with appropriate material. Subgrades shall be inspected by a qualified inspector to ensure compaction requirements are met. Submit test reports and field logs to PPR for review and for record.
- K. Existing on-site soils shall be evaluated for suitability for use in construction and for environmental contaminants by licensed and qualified professionals, including geotechnical engineers and environmental scientists. Many City sites contain various types of urban fill and may include abandoned below-grade structures. Evaluation shall be completed prior to design and engineering of new features. Environmental due diligence and/or testing shall be completed near the beginning of the design phase to determine whether on-site materials are clean or regulated. Testing shall comply with Pennsylvania Department of Environmental Protection requirements for fill management. Submit geotechnical testing and environmental due diligence reports to the owner for review and for record.

- L. Any soil materials leaving the site or being brought to the site shall comply with the Pennsylvania Department of Environmental Protection requirements for fill management.

PART 2 - PRODUCTS

2.1 ON-SITE FILL

- A. On-site excavated materials may be used as backfill provided they meet the following criteria:
 - 1. Suitable backfill materials include soil that complies with ASTM D 2487 soil classifications GW, GP, GM, SW, SP, and SM and having a maximum particle size of three (3) inches in any one dimension.
 - 2. Unsuitable backfill materials include any material having an excess of wood, timber, metal, rebar, organics, debris, or any other deleterious materials.
- B. It is not permitted for excavated materials unsuitable for fill in their as-is state to be processed on-site to comply with suitable backfill requirements. Concrete, brick, asphalt debris is not permitted to be broken or crushed on site to meet the above particle size requirement.
- C. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule.
- D. Prior to placement, on-site material to be used as fill shall not contain:
 - 1. Debris other than crushed concrete and brick meeting the above requirements.
 - 2. Timber or railroad ties.
 - 3. Other deleterious materials such as steel rails, rebar, trash, etc.
 - 4. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.
 - a. If contaminated, hazardous, or regulated soil is encountered that was not identified in the Contract Documents or preconstruction environmental reports, the Contractor shall immediately suspend work in the affected area and notify the Owner and Engineer.
 - b. The Owner will retain a qualified environmental professional to evaluate the material and determine appropriate handling, testing, and disposal requirements in accordance with applicable federal, state, and local regulations.
 - c. The Contractor shall cooperate with the Owner and environmental consultant in isolating the affected area and protecting the material from spreading.
 - d. Work in the affected area shall not resume until written direction is provided by the Owner or Engineer.
 - e. Handling and disposal of contaminated material will be addressed as a change in the work unless otherwise indicated in the Contract Documents.
- E. Any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

2.2 OFF-SITE IMPORTED FILL

- A. If necessary, off-site fill shall be obtained and provided by the Contractor;
- B. Fill shall be clean, well graded granular soil which is non-expansive and non-collapsible and shall have less than 20% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic. Fill with less fines (less than #200) may be required on project specific basis and as required by engineer of record. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in the geotechnical engineering study;

- C. Imported fill shall be free of all hazardous substances. Imported fill shall comply with Pennsylvania DEP Fill Management Policy and must be documented as Clean Fill or Regulated Fill as applicable. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the Owner and engineer of record by the Contractor not less than one week prior to its intended use;
- D. The Owner reserves the right to test off-site fill material for conformance with these specifications; and,
- E. The Contractor shall be responsible for all permits and regulatory requirements associated with off-site borrow sources.
- F. All imported fill shall comply with Pennsylvania Department of Environmental Protection requirements for fill management.

2.3 STONE BACKFILL

- A. In accordance with PennDOT Publication 408, Section 703 for AASHTO No. 57 Stone.

2.4 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - 3. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 - 4. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - 5. Tear Strength: 90 lbf; ASTM D 4533.
 - 6. Puncture Strength: 90 lbf; ASTM D 4833.
 - 7. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 8. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 9. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.5 EQUIPMENT

- A. Compactor for mass earthwork shall be minimum 10-ton static-drum weight vibratory roller or 10-ton static-drum weight sheep foot compactor as appropriate for the type of soil material at the site or other compactor approved by the engineer of record.
- B. Compactor for trenches and where access or maneuverability is limited, use a double drum walk- behind roller or vibratory plate compactor or "jumping jack" tampers.
- C. Grading equipment including, but not limited to, Bulldozers, Skid-Steer Loaders, Excavators, and Backhoe Loaders shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less to limited soil compaction.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, site conditions, and all portions of the work falling under this section.

- B. The Contractor shall refer to the soil erosion and sediment control drawings for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.
- C. Locate and identify existing utilities that are to remain and protect them from damage.
- D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.
- E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.
- F. The Contractor shall be responsible for maintaining the stability of excavations and protecting adjacent structures, utilities, and improvements during construction.
- G. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the Owner.
- H. Remove from the site, material encountered in grading operations that, in opinion of Owner or engineer of record, is unsuitable or undesirable for backfilling as per Article 2.01.
- I. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the drawings.
- J. Do not allow or cause any of the work performed or installed to be covered by work of this section prior to all inspections, tests and approvals.
- K. Perform excavation using capable, well maintained equipment and methods acceptable to the Owner and regulatory authorities having jurisdiction.
- L. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range three (3) percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.
- M. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.
- N. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the Owner.

3.2 COMPACTION OF SUBGRADE SURFACES

- A. In areas to receive fill and at the final cut subgrade, proof roll and compact the exposed ground surface following clearing and grubbing and any required excavation with a minimum of four (4) passes of an approved compactor and obtain at least the following density requirement:

Location	Percent of Maximum Dry Density per ASTM D698	Percent of Maximum Dry Density per ASTM D1557
Foundation Support, Pavements, and Wall Backfill	98%	95%

Utility Trenches and Walkways	95%	93%
Non-structural	85%	82%

- B. The proof roll, truck and compactor equipment shall traverse the area at speed that permits the inspector to comfortably walk alongside the equipment.
- C. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified above.

3.3 UNDERCUT EXCAVATION

- A. When approved by the Owner and recommended by the engineer of record, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.
- B. At locations where unstable or unsuitable soil is shown on the drawings or identified within the geotechnical report, the removal and replacement of such soil shall be as directed on the drawings or as directed by the engineer of record and the Owner.
- C. All material removed in the work of undercut excavation will be classified by the engineer of record and Owner as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the work, or unsuitable for future use and manipulated as per Article 2.1.
- D. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.
- E. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the engineer of record.
- F. Undercut required due to unsuitable native soils shall be considered incidental to unclassified excavation unless otherwise directed by the Owner.

3.4 EXCAVATION, FILL AND SUBGRADE PREPARATION

- A. GENERAL
 - 1. Refer to Sections 024116, Structure Demolition and 024119 Selective Demolition, for demolition information and requirements pertaining to below-grade utilities.
 - 2. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the drawings. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.
- B. EXCAVATION
 - 1. Where existing grades are above proposed subgrade elevation, excavate materials to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades;
 - 2. Excavate organic soils that do not provide adequate foundation support. Excavated on-site organic soils, which are unsuitable for fill may be used in landscaped areas and, if approved by the engineer of record, as fill in parking area at least 5 feet below final elevation. Otherwise this material shall be disposed of as directed by Owner;

3. Excavated on-site soils, which meet the requirements of suitable fill may be used as fill; and,
4. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the engineer of record for use as on-site fill, shall be disposed of as directed by Owner.

C. FOUNDATIONS

1. Building foundations shall bear on undisturbed soil having minimum bearing capacity of 2500 psf. Adjust bottom of footing elevations as required to bear on uniformly dense inorganic subgrade.
2. Subgrade shall be protected from disturbance between inspection and placement of concrete.
3. All exterior footings shall be placed a minimum of 3'-0" below final grade. Footings shall be placed such that the line drawn between the lower edges of adjoining footings shall not have a slope steeper than 30 deg from the horizontal. Footings shall be stepped at a rate of 2 horizontal feet to one vertical foot.
4. Excavations for any purpose shall not remove lateral support from any footing or foundation without protecting the footing or foundation against settlement or lateral translation.

D. SPECIAL INSPECTIONS

1. Special inspections required by the Building Code shall be retained and paid for by the Owner unless otherwise noted in the Contract Documents.
2. The independent inspections agency shall perform inspections and submit reports to the Engineer of Record (EOR) within 72 hours of inspection. Any inadequacies found by the Inspector shall be reported to the EOR within 24 hours. The Contractor shall facilitate these inspections by scheduling the inspections to coordinate with the work being performed by their sub-contractors.
3. Work requiring special inspection shall not be concealed until inspected and approved.

E. SUBGRADE PREPARATION FOR FILL

1. Existing grades below proposed grades and thus requiring fill shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill; and,
2. All existing grades to receive fill areas shall be proof rolled and compacted per Article 3.02.
3. Loose/Soft and unstable subgrade resulting from excessive moisture may be aerated and dried in-place. Following adequate drying time, the subgrade is to be densified in-place. Subgrade that cannot be aerated, dried, and densified in place shall be removed as described in Article 3.03.

F. FILL PLACEMENT

1. Rock or processed suitable debris pieces larger than six inches (6 inches) across shall not be part of fill;
2. Reduce soil clod size to a maximum of 2 inches before placement. Do not place frozen fill material;
3. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the engineer of record;
4. No fill materials shall be placed during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to a satisfactory moisture content as determined by the testing agency;
5. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any work day when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day;

6. The fill shall be placed in uniform loose lifts not exceeding 8-inches thick and compacted with at least 4 coverages of a 10-ton static-drum weight roller;
7. Each lift shall be compacted to the minimum densities listed in Article 3.2 as appropriate for the project and as specified in the geotechnical engineering report;
8. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule;
9. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval of the Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule;
10. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the Owner or Owner's representative. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section; and,
11. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

3.5 PROOFROLLING

- A. The work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Owner's representative and/or engineer of record.
- B. Proofrolling shall be under the observation of the Owner's representative and/or the testing agency as described herein and under the following schedule:
 1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified; and,
 2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material or stone base course as directed by the engineer of record and approved by the Owner.
- C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 lbs., or other construction equipment if approved by the engineer.
- D. Construction methods shall be as follows:
 1. After the subgrade or stone base course has been completed within 0.50 foot of final grade, the subgrade or stone base course shall then be compacted and tested prior to commencement of proofrolling. The coverage areas and methods will be identified by the Owner's representative and/or engineer. However, the roll shall be operated in a systematic manner so that the number of coverages over all areas to be proofrolled can be readily determined and recorded;
 2. The equipment shall be operated at a speed that the inspector can comfortably and slowly walk alongside the equipment;
 3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Article 3.03. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor or weather, the corrective work and additional proofrolling shall be performed by the Contractor at no cost to the Owner; and,
 4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

3.6 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.
- C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section.

3.7 FINISH ELEVATIONS AND LINES

- A. For setting and establishing finish elevations and lines, secure the services of a licensed land surveyor acceptable to the Owner and engineer.
- B. Provide elevation grade stakes and any other surveying necessary for the layout of the work. The Contractor shall conduct his work in such a manner that survey stakes will be protected as long as their need exists. Grade stakes, which are damaged or stolen, shall be replaced by the Contractor's surveyor at the Contractor's expense.
- C. Graded areas shall be uniform, hard and smooth, free from rock, debris, or irregular surface changes. Any deviation shall not result in changes in drainage areas or ponding. All ground surfaces shall vary uniformly between indicated elevations. Finish drainage ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize the potential for erosion.
- D. Correct all settlement and eroded areas for one year after date of project completion at no additional expense to Owner. Bring paved and landscaped areas to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.
- E. Adjust existing and new manhole, catch basin, and drain rim/grate elevations to match new finish grade elevations (pavement or soil) as applicable.
- F. Grade all tree, shrub, and groundcover planting beds to 3 inches below the top of abutting curbs, paving, or lawn areas to allow for mulching.

3.8 FIELD QUALITY CONTROL

- A. The testing agency shall perform observation and testing at frequencies specified in this Section and as necessary to verify compliance with the Contract Documents.
- B. The contractor shall allow the testing agency to inspect and test each subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. The testing agency shall test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 6938, ASTM D 2937, and ASTM D 4254 as applicable. Tests shall be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2200 sq. ft. or less of paved areas or building slab, but in no case fewer than three tests.
 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
 3. Structural Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
 4. The Engineer reserves the right to require additional testing if field conditions warrant.
- D. When the testing agency reports that subgrades, fills or backfills have not achieved degree of compaction specified, recompact and retest until specified compaction is obtained.
- 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from owner of the property where material is deposited.
- B. All soil materials leaving the site shall comply with Pennsylvania Department of Environmental Protection requirements for fill management.

END OF SECTION 310000

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SECTION 311000 – SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. The work under this Section shall include all labor, materials, and equipment necessary for Site Clearing as hereinafter specified and/or as otherwise required for the proper and timely completion of the Contract.
- B. This Section includes the following:
 - 1. Removing surface debris.
 - 2. Removing designated paving; curbs; and existing features including, but not limited to inlets, pipes, and fencing.
 - 3. Removing designated trees, shrubs, and other plant life.
 - 4. Removing abandoned utilities.
 - 5. Removing above- and below-grade site improvements.
 - 6. Excavating topsoil.
 - 7. Clearing and grubbing.
 - 8. Cut and treat vegetation.
 - 9. Protecting existing vegetation to remain.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirements:
 - 1. Section 015000 Temporary Facilities and Controls for temporary erosion- and sedimentation-control measures.
 - 2. Section 015639 “Temporary Tree and Plant Protection”.
 - 3. Section 017300 “Execution” for cutting and patching procedures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Topsoil: Top layer of soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become the Contractor's property and shall be disposed of in accordance with all applicable regulations.

1.5 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing
 1. Use sufficiently detailed photographs or video recordings.
 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify PA One Call for area where Project is located prior to site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sediment-control and plant-protection measures are in place.
- E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection"
- F. Owner will occupy building immediately adjacent to site clearing area. Conduct work so Owner's operations will not be disrupted.
- G. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with site clearing.
- H. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and engineer to receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.
- I. All benchmarks and monuments shall be protected during construction. If disturbed or destroyed, they shall be replaced in original position by a licensed surveyor at the Contractor's expense.

- J. Maintain existing utilities indicated to remain in service and protect them against damage during site clearing operations.
- K. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. The contractor shall provide and use all necessary equipment and materials to perform the work described herein.

2.2 HERBICIDE

- A. Herbicides: Approved before use for type and rate of application by Owner and local, state, and/or federal agencies with jurisdiction. Spraying of all herbicides shall be done in accordance with the Chemical Spraying Program.
 - 1. Non-selective herbicide shall be Round-Up as manufactured by Monsanto or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Verify the utilities have been disconnected and capped before starting selective demolition operations.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of site clearing required.

3.2 PREPARATION

- A. Call the Pennsylvania One Call System at 1-800-242-1776 not less than three working days before performing work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Provide erosion control measures in accordance with Section 312500, Soil Erosion and Sediment Control, prior to any construction activity.
- C. Limit of clearing is to be staked and verified by Owner or engineer prior to removal of any material.

- D. Verify that trees, shrubs, and other vegetation to remain have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plan Protection".
- E. All trees and shrubs not designated to remain within the area to be graded, whether shown or not on the drawings, shall be cut and the stumps shall be completely dug out. Burning on site is not permitted.
- F. Protect and maintain benchmarks and survey control points from disturbance during construction.

3.3 PROTECTION

- A. The Contractor shall protect existing underground utilities from damage. The accuracy of the utilities shown on the plan as to line and grade is not guaranteed. Any damage caused by the Contractor to any utility shall be the responsibility of the contractor to correct.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted. If utilities are interrupted, arrange to provide temporary utility services.
 - 1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruption without Owner's written permission.
- C. All trees and vegetation to remain shall be barricaded and protected during the construction process in accordance with plans and requirements in Section 015639 "Temporary Tree and Plan Protection".
- D. Contractor shall protect existing site improvements to remain from damage during construction.
 - 1. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sediment-control Drawings and requirements of authorities having jurisdiction.
- B. Inspect, maintain, and repair erosion- and sediment-control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.5 CLEARING AND GRUBBING

- A. Clear areas required for access to site and excavation of Work.
- B. Remove trees and shrubs indicated. Remove stumps and main root balls.

- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Remove obstructions, objectionable material, rubbish, junk, trees, shrubs, grass, and other vegetation within the limit of disturbance to permit Work. Removal includes digging out stumps and obstructions and grubbing roots, unless otherwise specified.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 24 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site
- E. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers and compact each layer to a density equal to adjacent original ground as in accordance with Section 310000 - Earthwork.

3.6 CUT AND TREAT VEGETATION

- A. Cut shrubs and woody vines to a height of 2 inches above the existing grade. Immediately treat cut portion of stumps with approved herbicide to kill the root system.
 - 1. Do not damage or apply herbicide to trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Remove branches and vines from cut stumps.
 - 3. Leave stumps and roots intact from cut vegetation.
 - 4. Chip removed branches and dispose of off-site.

3.7 EXISTING UTILITIES

- A. Notify Owner and Architect of any unknown utilities uncovered during site clearing operations.

3.8 REMOVAL

- A. Remove existing above- and below-grade improvements as indicated on Drawings and necessary to facility new construction.
- B. Remove debris, rock, and extracted plant life from site.
- C. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Caw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
- D. Remove abandoned utilities. Indicate removal termination point for underground utilities on Record Documents.

- E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- F. Do not burn or bury materials on site. Leave site in a clean condition.
- G. Comply with requirements specified in Section 017419 - Construction Waste Management and Disposal. Legally dispose of waste off Owner's property.

3.9 TOPSOIL EXCAVATION

- A. Excavate topsoil from entire site within the limit of disturbance without mixing with foreign materials for use in finished grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 20 feet and protect from erosion.
- D. Remove excess topsoil not intended for reuse from site.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them of Owner's property.

END OF SECTION 311000

SECTION 312200 – GRADING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Grading shall include all work necessary to bring the designated locations of the project area to the grades shown on the Drawings.
- B. Grading shall include all Borrow Excavation, transporting, placement and compaction work required to provide the necessary material volumes to complete the designed grades for the project areas as shown in the Contract Drawings. Borrow Excavation work shall be comprised of two types of excavation:
 - 1. Common Borrow Excavation. This refers to soil material salvaged within the limit of disturbance of the project. This shall include soil that will be excavated and/or stockpiled in order to complete the work depicted in the Contract Drawings.
 - 2. Foreign Borrow Excavation. This refers to soil material required in addition to the material available from regrading operations and will come from approved sources outside the limits of the project.
- C. Finished grades to be landscaped or seeded shall include a minimum topsoil layer of six inches (6") or as indicated on the Drawings. Finished grades to be otherwise surfaced shall allow sufficient elevation for the completed surface to produce the finished grades and elevations as shown on the Drawings.
- D. Related Sections:
 - 1. Section 310000 – Earthwork: Compaction standards, structural fill, and trench backfill requirements.
 - 2. Section 311000 – Site Clearing: Clearing and grubbing.
 - 3. Section 312500 – Erosion and Sedimentation Controls.
 - 4. Section 329110 – Green Stormwater Infrastructure Soils: GSI soil placement and compaction within stormwater management areas.
 - 5. Section 334600 – Stormwater Management: CCP and as-built requirements for SMP installations.

1.2 REFERENCES

- A. It is the Contractor's responsibility to be thoroughly familiar with the most recent revision or amendment to the following:
 - 1. Philadelphia Water Department, Standard Details and Standard Specifications for Sewers.
 - 2. Philadelphia Water Department, Standard Specifications for Excavation, Refilling, Grading, Landscaping, and Repaving (12-49).
 - 3. Philadelphia Streets Department, Standard Specifications for Paving and Repaving.
 - 4. Philadelphia Streets Department, Standard Construction Items.
 - 5. PennDOT Publication 408, Section 201 – Clearing and Grubbing
 - 6. PennDOT Publication 408, Section 205 – Borrow Excavation
 - 7. PennDOT Publication 408, Section 206 – Embankment
 - 8. PennDOT Publication 408, Section 802 – Topsoil Furnished and Placed
 - 9. Philadelphia Parks and Recreation (PPR) Grading and Earthwork Standards (most recent version).
 - 10. Pennsylvania Department of Environmental Protection (PADEP) Management of Fill Policy, Clean Fill Policy (most recent edition).

1.3 QUALITY ASSURANCE

- A. The grading Contractor or subcontractor is subject to approval by the Owner/Authorized Representative.
- B. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the Owner/Authorized Representative.
- C. An as-built survey of completed grades and elevations shall be completed by the Contractor. This survey will be deliverable to the Owner/Authorized Representative, or as otherwise directed, prior to any landscaping installation or final surfacing (seeding, paving, etc.) operations.
- D. All Foreign Borrow Excavation fill materials brought onto the site shall comply with the PADEP Clean Fill Policy. The Contractor shall submit documentation confirming clean fill status for all imported materials prior to delivery to the site. On-site soils proposed for reuse as fill shall be evaluated by the geotechnical engineer or environmental scientist for suitability prior to placement.
- E. Where fill is placed within or adjacent to the stormwater infiltration basin, the geotechnical engineer shall approve subgrade conditions prior to placement of aggregate or geotextile. Refer to Section 334600 – Stormwater Management for equipment restrictions within the infiltration basin excavation area.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

- A. Fill material (both Common Borrow Excavation and Foreign Borrow Excavation) shall conform to Publication 408 Specifications, Section 205.
- B. All Foreign Borrow Excavation materials shall be free of seeds or live plant materials and all noxious or invasive plants and/or weeds. These materials shall be obtained from properly permitted and authorized sites. All Foreign Borrow Excavation materials shall also conform to the following:
 - 1. Less than 20% passing No. 200 Sieve (0.075 mm opening).
 - 2. Minimum dry mass density of 95 lb/ft³ determined by PTM No. 106, Method B.
 - 3. Maximum liquid limit of 65, determined by AASHTO T89.
 - 4. Plasticity index of not less than liquid limit minus 30 (for soils with liquid limits of 41 to 65), determined by AASHTO T90.
- C. All fill materials shall be free from clay lumps, brush, litter, roots, stones 2 in. and larger, and other foreign materials.
- D. Contaminated Fill: Fill materials exhibiting signs of contamination (discoloration, odor, sheen, or known historical contamination) shall not be used. Notify Owner/Authorized Representative immediately if potentially contaminated material is encountered during excavation or stockpiling. Costs associated with identification, handling, and disposal of contaminated material shall be addressed per the Contract Documents.

2.2 TOPSOIL

- A. Topsoil shall be acceptable friable loam that is reasonably free of subsoils, clay lumps, litter, roots or other plant materials, stones (2 in. and larger), and other foreign materials.
- B. Topsoil may be produced onsite from existing appropriate soils by adding organic plant matter (mulch, shredded plants, etc) to constitute ten percent (10%), as determined according to AASHTO T194, and fully combined with the soil stockpile. Soils with clay content greater than thirty-five percent (35%) or sand content greater than seventy percent (70%) shall not be considered amendable to topsoil by this method.

1. On-site soils used for topsoil production shall first be confirmed clean and suitable by the geotechnical engineer or environmental scientist prior to amendment and use.
 2. On-site soils used for topsoil production shall also comply with the PADEP Clean Fill Policy and shall not contain hydrocarbons, petroleum products, chemically prohibited substances, or any other elements considered toxic to vegetation. Clean fill certification documentation shall be submitted to Owner/Authorized Representative prior to use.
- C. Topsoil shall have a minimum sixty percent (60%) passing through the No. 10 (2 mm) sieve as defined by AASHTO T88.
- D. Topsoil for areas within or adjacent to the stormwater management system shall comply with the requirements of Section 329110 – Green Stormwater Infrastructure Soils where applicable. Do not use amended on-site topsoil within GSI soil installation areas without prior approval from Owner/Authorized Representative and PWD.

PART 3 - EXECUTION

3.1 GRADING

- A. Install all required Soil Erosion and Sedimentation Control measures as described in these Specifications or indicated on the Drawings. Phasing of Erosion and Sedimentation Control Measures shall follow the sequence provided, or barring provision of a specified sequence shall be installed as appropriate to the Work and as directed by the owner/Authorized Representative. At a minimum, downstream sediment protection, limit-of-disturbance fencing, and vehicle/tire cleaning shall be instituted prior to commencing any clearing or grading activities.
- B. Perform all clearing and grubbing work in accordance with PennDOT Publication 408 Specifications, Section 201.3, Clearing and Grubbing – Construction and as specified in section 31 1000 – Site Clearing. Complete all clearing and grubbing (including stump removal) before starting other grading work.
- C. In areas of fill, complete grading to within three feet (3') of finished grade before excavating for and constructing sewers.
- D. All grading work, except final grading where sewers are constructed in fill (see above), shall be completed within thirty (30) days of starting clearing and grubbing operations.
- E. Place embankment over pipes and embankment around manholes in accordance with the Standard Details and Standard Specifications for Sewers.

3.2 PLACEMENT AND COMPACTION OF FILL AND BACKFILL

- A. For general fill and backfilling, place materials in accordance with Section 206.3(b) (Embankment: Placement and Compaction) of PennDOT Publication 408.
- B. Where fill materials are to be placed within six inches (6") of the finished graded soil surface on areas that are to be revegetated, materials shall be compacted with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. Material shall not be placed in a wet or frozen condition.
- C. Compaction testing shall be performed by the Contractor at a frequency consistent with Section 310000 – Earthwork. Test results shall be submitted to Owner/Authorized Representative and shall demonstrate compliance with the compaction requirements of Section 310000 Article 3.2 prior to placement of subsequent lifts or final surface treatment.
- D. Equipment ground pressure within the stormwater infiltration basin excavation area shall not exceed 4 psi. Refer to Section 334600 – Stormwater Management Article 3.03D for equipment restrictions and logging requirements within the basin footprint.

3.3 PLACEMENT AND FINISH GRADING OF TOPSOIL

- A. Loosen or scarify all areas to be covered by topsoil to a minimum depth of three inches (3"). Remove and dispose of any stones or other objectionable material encountered.
- B. Place topsoil on the prepared areas, and (unless otherwise directed in the Drawings or by Owner/Authorized Representative) spread and compact to a uniform depth of six inches (6") to produce the elevations and grades as shown on the Drawings.
- C. Compact topsoil with a roller having a mass (weight) not over one-hundred-and-twenty pounds per foot width (120 lb/ft-width) of roller or by other acceptable methods as directed by Owner/Authorized Representative. A sheep foot roller may be used as appropriate.
- D. Material shall not be placed or compacted in a wet or frozen condition.

3.4 AS-BUILT SURVEY

- A. An as-built survey shall be completed by the Contractor and submitted to Owner/Authorized Representative for approval prior to commencing final surfacing operations, including paving or landscaping.
- B. The survey shall identify spot elevations sufficient to show the grading in accordance with the Drawings (or as modified by Owner/Authorized Representative). Spot elevations provided on the Drawings shall be duplicated as a minimum number of survey points for the as-built.
- C. Survey of as-built elevations and grades may be included in (or include) as-built dimensions and elevations for other infrastructure constructed under this Contract.
- D. Survey underground stormwater management basins in accordance with latest PWD as-built survey guidelines.
- E. The contractor shall maintain a copy of the Approved PCSMP on-site at all times and document all changes as they occur. The contractor shall not cover, backfill, or seal any SMP until all measurements required by the Construction Certification Package (CCP) have been recorded. Upon substantial completion, Record Drawings and the completed CCP shall be submitted to PWD. Record Drawings shall highlight information in accordance with the Approved PCSMP in yellow and identify any deviations in red ink. The contractor shall maintain all PCSMP construction records for five (5) years following contract completion.

END OF SECTION 312200

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SECTION 312316.13 – TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities from 5 feet outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.
4. Excavation protection systems (sloping, shoring, shielding) required for worker safety.

1.2 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 310000 – Earthwork: Compaction standards, structural fill, trench backfill requirements, PADEP fill management, and utility locating requirements.
2. Section 311000 - Site Clearing.
3. Section 315000 – Excavation Support and Protection: Excavation protection system design, materials, and installation requirements.
4. Section 334009 – Connections to Existing Structures.
5. Section 334200 – Stormwater Conveyance.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International (latest editions):

1. ASTM D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort.
2. ASTM D1556 – Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
4. ASTM D2167 – Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 – Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 – Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
7. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

C. Federal Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1926 Subpart P – Excavations.
2. 29 CFR 1926 Subpart C – General Safety and Health Provisions.

D. Commonwealth of Pennsylvania:

1. Pennsylvania Underground Utility Line Protection Law, Act 287 of 1974, as amended by Act 50 of 2017.

2. PADEP Chapter 102 – Erosion and Sediment Pollution Control.
3. PADEP Policy on Management of Fill (25 Pa. Code Chapters 271 and 287).

E. City of Philadelphia:

1. Philadelphia Water Department Standard Specifications and Standard Details (most recent revision).
2. Philadelphia Department of Streets Standard Specifications for Paving and Repaving.

F. Philadelphia Parks and Recreation (PPR):

1. PPR Design and Construction Standards (January 2019, Updated May 2025), Division 31 Outline Specifications.

1.4 WORKER SAFETY — OSHA REQUIREMENTS

A. General Compliance:

1. All excavation and trenching Work shall comply with OSHA 29 CFR 1926 Subpart P – Excavations, and all other applicable OSHA standards including 29 CFR 1926 Subpart C (General Safety and Health Provisions). These requirements are minimum standards; where the Contract Documents or referenced standards impose more stringent requirements, the more stringent requirement shall govern.
2. OSHA Subpart P requirements apply to all excavations regardless of depth. Specific protective system requirements are triggered at 5 feet of depth or where a competent person determines a hazard exists.
3. Nothing in this Section relieves the Contractor of the sole responsibility for worker safety in and around excavations and trenches.

B. Competent Person:

1. The Contractor shall designate a Competent Person, as defined by OSHA 29 CFR 1926 Subpart P, for all excavation and trenching operations. The Competent Person shall be on-site whenever excavation work is in progress.
2. The Competent Person shall be capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and shall have authorization to take prompt corrective measures to eliminate hazards.
3. Duties of the Competent Person include, but are not limited to:
 - a. Classifying soil at each excavation in accordance with OSHA 29 CFR 1926 Subpart P, Appendix B (Soil Classification). Soil shall be classified as Type A, Type B, or Type C, or as fissured or layered, based on visual and manual tests.
 - b. Selecting the appropriate protective system (sloping/benching, support systems, or shield systems) based on the soil classification and site conditions.
 - c. Inspecting all open excavations, adjacent areas, and protective systems at the beginning of each work shift, after any rainstorm or other hazard-increasing occurrence, and as needed throughout the shift.
 - d. Ordering evacuation of the excavation whenever a hazardous condition is detected, until appropriate measures have been taken to ensure worker safety.
 - e. Ensuring that no workers enter an excavation that has not been inspected at the beginning of that shift.

C. Protective Systems:

1. All excavations 5 feet or deeper shall be protected by one of the following systems, selected and designed by the Competent Person in accordance with OSHA 29 CFR 1926 Subpart P and detailed further in Section 315000 – Excavation Support and Protection:
 - a. Sloping or benching of the excavation walls (Appendix B to Subpart P).
 - b. A support system (timber shoring, aluminum hydraulic shoring, or equivalent).
 - c. A trench shield (trench box) or other shield system.
 2. Excavations less than 5 feet in depth shall also be protected where the Competent Person determines that hazardous ground movement may occur (e.g., in Type C soils, near surcharge loads, or near existing structures).
 3. Protective systems shall be designed and used in accordance with:
 - a. OSHA 29 CFR 1926 Subpart P, Appendix B (Soil Classification), Appendix C (Timber Shoring for Trenches), Appendix D (Aluminum Hydraulic Shoring for Trenches), and Appendix F (Selection of Protective Systems).
 - b. For protective systems not covered by OSHA Appendices C and D, design by a Registered Professional Engineer licensed in Pennsylvania is required. Designs shall be submitted to the Owner/Engineer prior to use.
- D. Access and Egress:
1. Provide safe means of access and egress for workers in all excavations 4 feet or deeper. Provide ladders, steps, ramps, or other approved means. Lateral travel distance to an access/egress point shall not exceed 25 feet.
- E. Atmospheric Hazards:
1. Test excavations deeper than 4 feet for atmospheric hazards (oxygen deficiency, flammable gas, toxic gas or vapor) where these hazards could reasonably exist, before workers enter. Testing shall be performed by the Competent Person using calibrated instruments.
 2. Provide adequate ventilation in excavations where atmospheric hazards exist or may exist.
- F. Water Accumulation:
1. Do not allow workers to enter excavations in which water has accumulated or is accumulating unless adequate precautions have been taken to protect workers from the hazard of cave-in, collapse, or drowning. These precautions include, but are not limited to, use of a water removal pump, inspections by the Competent Person, and maintenance of protective systems.
- G. Surface Encumbrances and Spoil Placement:
1. Remove or support all surface encumbrances located so as to create a hazard to employees
 2. Keep excavated materials (spoil) and equipment at least 2 feet from the edge of excavations. Use barricades where necessary.
- H. Excavation Protection Plan:
1. Prepare an Excavation Protection Plan under the direct supervision of a Competent Person and, where required by OSHA, a Registered Professional Engineer licensed in Pennsylvania. Submit Plan to the Owner/Engineer for review not less than 10 business days before commencing excavation Work. The Plan shall include:
 - a. Identification of the Competent Person and, where applicable, the Registered Professional Engineer.
 - b. Soil classification methodology and anticipated soil types.
 - c. Selected protective system type(s) and design basis.
 - d. Access/egress plan.
 - e. Water control and dewatering plan.

- f. Emergency response procedures.

1.5 PENNSYLVANIA ONE CALL — UTILITY NOTIFICATION

- A. Contact the Pennsylvania One Call System, Inc. at 8-1-1 or 1-800-242-1776 not less than three (3), but no more than ten (10), business days before performing any excavation or trenching Work. A business day is any day except Saturday, Sunday, or a legal holiday prescribed by Pennsylvania statute, beginning at 12:00:00 a.m. and ending at 11:59:59 p.m. Comply with all requirements of the Pennsylvania Underground Utility Line Protection Law, Act 287 of 1974, as amended by Act 50 of 2017.
- B. Request that all underground utilities be located and marked within and surrounding construction areas. Do not begin excavation until markings are complete and verified.
- C. In addition to the 811 notification, research available utility records from PWD, Philadelphia Gas Works, PECO, and all other applicable utility owners for the project site, consistent with PPR Design and Construction Standards Section 310000.Q and ASCE C-I 38-02 (Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data). Determine the appropriate Quality Level (A, B, C, or D) of utility information required and obtain that information in consultation with Philadelphia Parks and Recreation.
- D. Perform excavation within 24 inches of any existing located utility by hand tools only.
- E. Immediately stop work and notify the Owner/Engineer and appropriate utility owner if any utility is damaged during excavation. Do not resume work until authorized by the utility owner and Owner/Engineer.

1.6 DEFINITIONS

- A. Competent Person: As defined in OSHA 29 CFR 1926.650 — one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
- B. Excavation: Any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal.
- C. Trench: A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- D. Protective System: A method of protecting workers from cave-ins, from material that could fall or roll into an excavation, or from collapse of adjacent structures. Includes sloping and benching, support systems, shield systems, and other systems providing the necessary protection.
- E. Utility: Any buried pipe, duct, conduit, or cable.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Philadelphia standards, PPR Design and Construction Standards, PennDOT Publication 408 (current edition), PWD Standard Specifications, and all applicable OSHA regulations.

- B. Maintain one copy of this Section, Section 315000, OSHA 29 CFR 1926 Subpart P, and the approved Excavation Protection Plan at the project site for the duration of all excavation and trenching Work.

1.8 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the City of Philadelphia.

1.9 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.
- B. Verify field measurements prior to fabrication.
- C. Coordinate with Section 315000 – Excavation Support and Protection for all shoring, shielding, and bracing design and installation.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. Owner/Engineer reserves the right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Pennsylvania One Call notification: Contact PA One Call (811) as required by Article 1.5 before performing any Work. Do not commence excavation until all underground utilities have been located and marked.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- D. Protect benchmarks, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above- and below-grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. The Contractor shall obtain all necessary permits to perform work within the public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

- G. Remove or support all surface encumbrances that could create a hazard to employees. Keep spoil and equipment at least 2 feet from the edge of all open excavations.

3.3 PRE-EXCAVATION AND DAILY OSHA INSPECTIONS

- A. The Competent Person shall inspect all excavations, adjacent areas, and protective systems:
 - 1. Before employees enter the excavation at the beginning of each work shift.
 - 2. After every rainstorm or other occurrence that could increase hazard (including but not limited to freeze-thaw cycles, vibration from equipment or nearby traffic, and water accumulation).
 - 3. As conditions warrant throughout each shift.
- B. The Competent Person shall document each inspection, noting date, time, soil conditions, protective system condition, and any corrective actions taken. Inspection records shall be available at the project site.
- C. If the Competent Person identifies hazardous conditions, all workers shall immediately evacuate the excavation. Work shall not resume until the Competent Person certifies that the hazard has been eliminated or controlled.

3.4 TRENCHING

- A. Excavate subsoil required for utilities as indicated on the Drawings.
- B. Remove lumped subsoil, boulders, and rock up of 1/6 cu. yd., measured by volume. Remove larger material as specified in Section 310000.
- C. Perform excavation within 24 inches of existing utility service in accordance with utility company's requirements.
- D. Do not advance open trench more than 200 feet ahead of installed pipe.
- E. Cut trenches sufficiently wide to enable installation and inspection, and to accommodate the protective system required by Article 1.4. Remove water or materials that interfere with Work.
- F. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Excavation wall protection — install the appropriate protective system as specified in Article 1.4 and Section 315000 before workers enter the trench:
 - 1. Where site conditions permit, slope excavation walls in accordance with the soil classification determined by the Competent Person per OSHA Appendix B. Maximum slopes are:
 - a. Type A soil: $\frac{3}{4}$ H:1V (53 degrees from horizontal).
 - b. Type B soil: 1H:1V (45 degrees from horizontal).
 - c. Type C soil: $1\frac{1}{2}$ H:1V (34 degrees from horizontal).
 - 2. Where sloping is not possible due to space constraints, soil instability, or proximity to structures, provide sheeting and shoring or a trench shield as specified in Section 315000.

3. Previously disturbed soil or fills shall be classified as no more favorable than Type B, unless the Competent Person determines, after testing, that a more favorable classification is warranted.

- J. When subsurface materials at the bottom of the trench are loose or soft, excavate to greater depth as directed by Owner/Engineer until suitable bearing material is encountered.
- K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with clean sand or sand and gravel (maximum gravel size 1.5 inches) and compact to a density equal to or greater than the requirements for subsequent backfill material.
- L. Correct over-excavated areas with compacted backfill as specified for authorized excavation, or replace with fill concrete as directed by Owner/Engineer.
- M. Stockpile subsoil in areas designated on the site to a depth not exceeding 20 feet and protect from erosion. Manage all excavated material in accordance with PADEP fill management requirements as specified in Section 310000 – Earthwork, Articles 1.9.K through 1.9.O.

3.5 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations as required to prevent danger to workers, structures, and adjacent properties, and to prevent caving, erosion, and loss of surrounding subsoil. Comply with OSHA 29 CFR 1926 Subpart P and Section 315000 – Excavation Support and Protection.
- B. All trenches 5 feet or deeper shall be protected as required by Article 1.4 before workers enter. Trenches less than 5 feet shall be protected where the Competent Person determines a hazard exists.
- C. Design sheeting and shoring systems in accordance with Section 315000. Where sheeting and shoring is intended to remain in place as part of the completed Work, cut off a minimum 18 inches below finished grade, unless otherwise directed by the Owner/Engineer.
- D. Sheeting and shoring within or immediately adjacent to infiltration basin footprints shall be fully removed to avoid interference with infiltration performance.
- E. The Contractor is solely responsible for the adequacy of sheeting, shoring, and bracing. Repair all damage caused by failure of protective systems and any resulting settlement of filled excavations or adjacent soil. Such repairs shall be at no additional cost to the Owner.

3.6 BACKFILLING

- A. Backfill trenches to the contours and elevations indicated on the Drawings using unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact in accordance with Section 310000 – Earthwork.
- D. Employ placement methods that do not disturb or damage utilities in the trench.
- E. Maintain optimum moisture content of fill materials to attain the required compaction density.

- F. Do not leave more than 50 feet of trench open at the end of a working day. Where trenches must remain open overnight, protect open trenches with barricades, covers, or other measures to prevent danger to the public, in accordance with Philadelphia Streets Department requirements.

3.7 TOLERANCES

- A. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.8 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556 (sand-cone method) or ASTM D6938 (nuclear gauge).
 - 2. Moisture Tests: ASTM D3017 or ASTM D6938.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to the Owner.

3.9 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 312316.13

SECTION 312350 – SAWCUTTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes the saw-cutting of existing concrete, bituminous pavement, and footway at the locations indicated on the plans.

1.2 RELATED DOCUMENTS

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

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Saws shall be equipped with guides, blade guards, water-cooling system and cut-depth control. Sawcut shall be done at the nearest joint, if applicable. The joint shall be sawed continuously and shall be of sufficient depth to allow removal of the paving without disturbing the paving that is to remain.
- B. Contractor to mark out sawcut lines in field for approval by the Owner or Authorized Representative prior to proceeding with the pavement removal.

END OF SECTION 31 23 50

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SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work of this Section includes all temporary erosion and sediment control and related and incidental operations, including:
 - 1. Filter Bag Inlet Protection;
 - 2. Stone and Concrete Block Inlet Protection;
 - 3. Compost filter sock;
 - 4. Temporary seeding and mulching;
 - 5. Rock Construction Entrance;
 - 6. Pumped Water Filter Bag;
 - 7. Compost Sock Washout Station; and,
 - 8. Maintenance and repair of erosion and sediment control measures.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 310000 – Earthwork: PADEP fill management requirements applicable to stockpiled excavated material; utility locating requirements prior to earth disturbance.
 - 2. Section 311000 - Site Clearing.
 - 3. Section 321216 - Asphalt Paving.
 - 4. Section 321600 - Concrete Sidewalks.
 - 5. Section 334600 – Stormwater Management: Post-construction stormwater management requirements and PWD Construction Certification Package.

1.3 REGULATORY PERMITS AND PLANS

- A. General — Applicability:
 - 1. All earth-disturbing activities on this project, regardless of the area of disturbance, are subject to the requirements of PADEP Chapter 102 (Erosion and Sediment Pollution Control), 25 Pa. Code Chapter 102. The Contractor shall comply with all applicable requirements of Chapter 102 from the commencement of earth disturbance through achievement of final stabilization.
 - 2. The permit and plan requirements in this Article are in addition to, and do not relieve the Contractor of compliance with, any other applicable local, state, or federal environmental regulations.
- B. PADEP Chapter 102 — Erosion and Sediment Pollution Control (E&SPC) Plan:
 - 1. An Erosion and Sediment Pollution Control (E&SPC) Plan meeting the requirements of 25 Pa. Code Chapter 102 and the PADEP Erosion and Sediment Pollution Control Program Manual (latest edition) is required for this project. The E&SPC Plan requirement applies to ALL earth disturbance activities, including projects disturbing less than one (1) acre.
 - 2. The E&SPC Plan shall be prepared by a Registered Professional Engineer or other qualified professional acceptable to PADEP and the Owner/Engineer, and shall be consistent with the erosion and sediment control measures shown on the Contract Drawings and specified in this Section.
 - 3. The E&SPC Plan shall include, at minimum:

- a. A narrative describing the nature, purpose, and location of the earth disturbance activity.
 - b. A site map showing the limits of disturbance, drainage patterns, existing and proposed grades, locations of all E&S control measures, receiving waters, and properties adjacent to the project site.
 - c. A sequenced schedule for installation of E&S controls relative to the construction sequence, including activation of controls before earth disturbance in each tributary area.
 - d. Specifications and details for all E&S control measures.
 - e. A temporary and permanent stabilization plan, including seeding specifications and stabilization deadlines consistent with Article 3.6 of this Section.
 - f. A post-construction inspection and maintenance plan for permanent E&S features.
4. The E&SPC Plan shall be submitted to the Owner/Engineer for review and approval not less than fourteen (14) calendar days before commencement of earth disturbance. The approved E&SPC Plan shall be kept on the project site at all times and made available to PADEP, PWD, and the Owner/Engineer upon request.
 5. All changes to the approved E&SPC Plan must be reviewed and approved by the Owner/Engineer and, where required by Chapter 102, by PADEP, prior to implementation.

C. NPDES Construction General Permit (CGP) — PAG-02:

1. A PADEP NPDES Construction General Permit (CGP), Permit No. PAG-02, is required for earth disturbance activities that meet one or more of the following thresholds:

Disturbance / Condition	Permit / Plan Requirement
Disturbance $\geq$ 1 acre	NPDES CGP (PAG-02) coverage required before earth disturbance begins. An E&SPC Plan meeting NPDES requirements (including a Stormwater Pollution Prevention Plan, SWPPP) must be prepared and approved.
Disturbance < 1 acre — part of larger common plan	NPDES CGP coverage required if the project is part of a larger common plan of development or sale that will ultimately disturb 1 acre or more (25 Pa. Code § 92a.2).
Disturbance < 1 acre — standalone	NPDES CGP not required, but PADEP Chapter 102 E&SPC Plan is still required (see Article 1.3.B above).
Any disturbance — special waters	Contact PADEP for individual permit requirements if the project site drains to or is within 100 feet of High Quality (HQ) or Exceptional Value (EV) waters, or involves wetlands.

2. Responsibility for obtaining the NPDES CGP rests with the Owner unless the Contract Documents specify otherwise. The Contractor shall not commence earth disturbance until the Owner/Engineer has confirmed in writing that required NPDES permit coverage is in place.
3. The NPDES CGP requires preparation of a Stormwater Pollution Prevention Plan (SWPPP). Where required, the SWPPP shall incorporate the E&SPC Plan described in Article 1.3.B. The SWPPP shall be kept on the project site and made available to PADEP, PWD, and the Owner/Engineer upon request.
4. NPDES CGP Notice of Intent (NOI): The Owner or Owner's authorized agent shall submit a complete NOI to PADEP at least seven (7) days before earth disturbance begins. The Contractor shall cooperate fully in providing site information required to complete the NOI.
5. NPDES CGP Notice of Termination (NOT): Upon achievement of final stabilization and completion of all post-construction requirements, the Owner or Owner's authorized agent shall submit a NOT to PADEP. The Contractor shall provide written certification to the Owner/Engineer that the site has achieved final stabilization as defined in Article 3.6 before the NOT is submitted.

- D. Inspection and Reporting Under NPDES CGP:
1. Where NPDES CGP coverage is required, the SWPPP shall be implemented and maintained throughout construction. Inspections shall be conducted by a trained inspector meeting PADEP Chapter 102 requirements and at the minimum frequencies required by the permit:
 - a. At least once every seven (7) calendar days; and
 - b. Within 24 hours after any precipitation event of 0.5 inch or greater in a 24-hour period.
 2. Inspection reports shall document: date and time of inspection, name and credentials of inspector, weather conditions, observations of E&S controls (condition, adequacy, deficiencies), and all corrective actions taken or required. Inspection reports shall be retained at the project site for a minimum of three (3) years and made available to PADEP upon request.
 3. Where NPDES CGP is not required, the inspection and documentation requirements of Article 3.1.D and E of this Section (weekly inspections and post-precipitation inspections) continue to apply.
- E. PWD Coordination:
1. The E&SPC Plan and SWPPP (where required) shall be prepared consistent with the Philadelphia Water Department Philadelphia Stormwater Management Guidance Manual (current version). Submit copies of the approved E&SPC Plan and any NPDES permit documentation to PWD as required by the PWD Stormwater regulations and the project's PWD Construction Certification Package requirements.
 2. Silt fences, compost filter socks, and other temporary E&S measures shall be inspected as required by PWD/PADEP requirements, as referenced in PPR Design and Construction Standards Section 015719.

1.4 REFERENCES

- A. Commonwealth of Pennsylvania, Department of Environmental Protection (PADEP):
1. PADEP Erosion and Sediment Pollution Control Program Manual (most recent version).
 2. 25 Pa. Code Chapter 102 – Erosion and Sediment Pollution Control.
 3. 25 Pa. Code Chapter 92a – National Pollutant Discharge Elimination System (NPDES) Permitting, Monitoring and Compliance. NPDES Construction General Permit No. PAG-02.
- B. Commonwealth of Pennsylvania, Department of Transportation (PennDOT):
1. Bulletin No. 15: Approved Construction Materials.
 2. Publication 408/2020 Specifications.
- C. Philadelphia Water Department, Philadelphia Stormwater Management Guidance Manual (current version).
- D. City of Philadelphia City Code and requirements by the Department of Licenses and Inspections.
- E. PPR Design and Construction Standards, January 2019 (Updated May 2025), Section 015719 – Environmental Controls.

1.5 SUBMITTALS

- A. E&SPC Plan: Submit the complete Erosion and Sediment Pollution Control Plan as required by Article 1.3.B for Owner/Engineer review and approval not less than fourteen (14) calendar days before earth disturbance begins.

- B. NPDES Documentation (where applicable): Prior to commencement of earth disturbance, provide the Owner/Engineer with copies of:
 - 1. The NPDES CGP NOI submitted to PADEP.
 - 2. PADEP acknowledgment of NOI receipt (or permit coverage confirmation).
 - 3. The SWPPP (incorporating the E&SPC Plan).
- C. Product Data: Submit complete shop drawings and product information for all E&S control items to be furnished under this Section upon receipt of notice to proceed and prior to construction.
- D. Inspection Records: Maintain complete written logs of all E&S control inspections as required by Articles 1.3.D and 3.1.E and make them available to PWD Inspector, Owner/Engineer, and PADEP upon request.

1.6 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary trades and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction. Construction operations shall be carried out in a manner such that soil erosion, air pollution, and water pollution is minimized. State, County, and Municipal laws concerning pollution abatement shall be followed.
- C. The requirements and standards set forth in 25 Pa. Code Chapter 102 (Erosion and Sediment Pollution Control) and the PADEP Erosion and Sediment Pollution Control Program Manual (latest edition) shall be applicable where work is not specifically detailed in this Specification, the accompanying Drawings, or the approved E&SPC Plan.
- D. The Contractor shall take action to remedy unforeseen erosion conditions and to prevent damage to adjacent properties as a result of increased runoff and/or sediment displacement. Stockpiles of wood chips, hay bales, crushed stone, and other mulches shall be held in readiness to deal immediately with emergency erosion problems. All erosion control checks and structures shall be inspected after heavy rainfalls, and if damaged, repaired or replaced.
- E. No earth disturbance or other construction activities may take place until the required E&SPC Plan has been approved by the Owner/Engineer, all required NPDES permit coverage is in place, and all required E&S control devices have been installed and approved by Owner/Authorized Representative. All changes to the approved E&SPC Plan and E&S controls must be approved by Owner/Authorized Representative — and by PADEP where required by Chapter 102 — prior to implementation.
- F. The Contractor shall establish and enforce ecological preservation measures to avoid pollution of the atmosphere, waterways, groundwater, plants, soil, animal habitats, landfills, wetlands, the site, adjacent sites, and roadways. The Contractor shall prevent spilling of chemicals or waste and shall provide emergency plans and methods for abatement of accidental spills of toxic substances.
- G. Legally dispose of all debris, chemicals, contaminated fill, and waste off the site in compliance with all applicable local, state, and federal regulations, including PADEP fill management requirements per Section 310000 – Earthwork. Collect and contain materials before disposal in an orderly fashion and by means that prevent contamination of air, water, and soil. Store chemicals in watertight containers. Do not burn materials on the site.

1.7 PRE-INSTALLATION MEETING

- A. Convene a minimum seven (7) days prior to commencing Work of this Section. Agenda shall include review of the approved E&SPC Plan, NPDES permit status, E&S control installation sequence, inspection responsibilities, and emergency response procedures.

PART 2 - PRODUCTS

2.1 FILTER BAG INLET PROTECTION

- A. Filter bags shall be manufactured with woven polypropylene geotextile and sewn by a double needle machine, using a high strength nylon thread. Filter bags shall have a design flow rate of 40 gpm/sf.
- B. Filter bags shall be manufactured to fit the opening of the catch basin or drop inlet. Filter bags will have the following features:
 - 1. Two dump straps attached at the bottom to facilitate the emptying of the bag;
 - 2. Lifting loops as an internal part of the system to be used to lift the filter bag from the basin;
 - 3. Restraint cord approximately halfway up the sack to keep the sides away from the basin walls, this cord is also a visual means of indicating when the sack should be emptied.
- C. Filter bag seams shall have a minimum certified average wide width strength per ASTM D4884 of 300 psi.
- D. Inlet filter bags for installation in new or existing highway grate and open mouth grate inlets shall be listed in PennDOT Bulletin 15 or approved equal.
- E. City inlet (and curb opening portion of open-mouth grate inlet) protection shall be a compost filter sock as described below and manufactured from recycled synthetic fibers.

2.2 STONE AND CONCRETE BLOCK INLET PROTECTION

- A. In accordance with PennDOT Publication 408, Section 860.2(b).
- B. Inlet protection in roadway is not to include stone or berms.

2.3 COMPOST FILTER SOCK

- A. Compost filter socks shall be a three-dimensional tubular sediment control listed in PennDOT Bulletin 15, or approved equal.

2.4 TEMPORARY SEEDING AND MULCHING

- 2.5 All stockpiles, inactive disturbed areas, and areas where grading has been completed shall be seeded and mulched with vegetative cover using seeding, mulch, and binder within five (5) days of exposure or completion of grading, as a temporary measure until permanent work establishes sediment control. This 5-day stabilization deadline is consistent with 25 Pa. Code Chapter 102 and PPR Section 015719.

2.6 ROCK CONSTRUCTION ENTRANCE

- A. Rock Construction Entrance shall be designed, dimensioned, and constructed in accordance with PennDOT Publication 408, Section 849, and the PADEP Erosion and Sediment Pollution Control Program Manual (latest edition), with the following minimum requirements:
1. Stone: Pennsylvania Department of Transportation No. 2 or No. 3 coarse aggregate (1½" to 3" nominal size), or approved equal as listed in PennDOT Bulletin 15. Stone shall be clean, angular, and free of fines.
 2. Depth: Minimum 6 inches of compacted stone.
 3. Width: Minimum full width of the access point used by construction vehicles, but not less than 12 feet. Where two-way traffic is anticipated, minimum 20 feet wide.
 4. Length: Minimum 50 feet, or as shown on the approved E&SPC Plan drawings if a greater length is required by site conditions.
 5. Underlayment: Non-woven geotextile fabric meeting PennDOT Publication 408, Section 735 requirements, placed beneath stone to prevent mixing of stone with subgrade.
 6. Drainage: Grade entrance to drain away from the public roadway, or provide a diversion berm at the roadway edge to direct drainage to a sediment trap or filter.
- B. Accumulated materials shall be cleaned from the rock entrance daily and as necessary and disposed of in accordance with all applicable regulations.
- C. Dump trucks shall be tarpaulin-covered so that spillage does not occur. Provide a gravel-surfaced truck wheel washing area at site entrances. Clean all truck wheels of mud, spoil, and debris before trucks leave the site.
- D. When the rock construction entrance becomes clogged or otherwise fails to prevent tracking of mud and sediment onto the public roadway, replenish or replace stone as necessary. If tracking onto the public roadway occurs, the Contractor shall immediately clean the roadway using street sweeping or other approved means at no additional cost to the Owner.

2.7 PUMPED WATER FILTER BAG

- A. Pumped water filter bags shall be provided in accordance with PennDOT Publication 408, Section 855.

2.8 COMPOST SOCK WASHOUT STATION

- A. Concrete washout water shall be directed to the compost sock washout station as indicated on the plans. The compost sock washout station shall be comprised of a compost filter sock in accordance with this specification.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All temporary erosion and sediment control measures specified herein, and all measures shown on the approved E&SPC Plan, shall be in place and approved by the Owner/Authorized Representative before the beginning of any earthwork or excavation in the tributary area of those controls.
- B. All erosion and sediment control devices shall be installed in accordance with the manufacturer's specifications, PennDOT Publication 408 Specifications, and the approved E&SPC Plan.
- C. When temporary erosion and sediment control measures as described herein do not provide adequate control, replacement or relocation of measures shall be implemented as directed by the Owner/Authorized Representative. Changes to the E&SPC Plan shall be approved as required by Article 1.6.E.
- D. Erosion and sediment control measures shall be inspected weekly and within 24 hours after every precipitation event of 0.5 inch or greater in a 24-hour period. Where NPDES CGP coverage is required, inspection frequency shall be as specified in Article 1.3.D, which governs over this Article in the event of conflict.
- E. Contractor shall maintain complete written logs of all inspections, documenting date, time, inspector name, weather conditions, condition of all E&S controls, deficiencies identified, and corrective actions taken or required. Make inspection logs available to PWD Inspector, Owner/Engineer, and PADEP upon request. Retain logs for a minimum of three (3) years.
- F. All maintenance work — including but not limited to cleaning, repair, replacement, regrading, and restabilization of temporary erosion and sediment control measures — shall be performed within 24 hours of identifying a deficiency, or immediately in the event of an imminent threat of discharge.
- G. Contractor shall ensure that all erosion and sedimentation control measures remain in place and fully functional until the site achieves final stabilization as defined in Article 3.6.
- H. Perform earthwork in phases to minimize the area and extent of exposed land at any one time. Control the rate of water runoff by diversion ditches, benches, berms, and other earth-formed shaping so that the rate of flow is retarded and silting is minimized. Reshape and restore conditions showing evidence of earth erosion.
- I. Keep dust down at all times, including non-working days, weekends, and holidays. Wet down or treat disturbed soil with approved dust suppressants as required. Do not leave areas of disturbed earth unworked for extended periods. Provide temporary or permanent earth stabilization promptly. If required, install perimeter fencing or tarpaulins to control dust leaving the site. Use wet-cutting methods for cutting concrete, asphalt, and masonry. Do not shake out bags containing dust-causing substances.
- J. Provide mufflers on all internal combustion engine equipment. Maximum noise level shall be 90 dBA at 50 feet. Limit hours of noisy construction to limits set by City ordinance.
- K. Maintain all environmental protection measures in working order until they are no longer required. Remove temporary control measures upon site stabilization and final acceptance, in accordance with Article 3.8.

3.2 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

3.3 PUMPED WATER FILTER BAG

- A. Sediment-laden water shall be pumped through a pumped water filter bag as specified herein.
- B. Filter bags shall be removed and replaced when they have reached their capacity to filter sediment effectively, or upon any breach of the filter bag.
- C. The Contractor shall not discharge to any sewer without the prior written approval of PWD. Discharge of construction dewatering or stormwater to the City's combined or separate sewer system requires a PWD authorization and must comply with applicable NPDES permit conditions.

3.4 TEMPORARY INLET PROTECTION

- A. The downstream inlets from the site of any disturbance or construction on the project site shall be protected with approved inlet protection practices. Downstream inlets are considered to be the next immediate inlet downslope that will receive runoff from the site of any disturbance, as well as any and all inlets within the site itself.
- B. All new inlets shall be protected with approved inlet protection practices upon installation. Inlets draining exclusively to a stormwater feature shall remain fully closed to runoff until final site cleanup.
- C. Final site cleanup shall include removal of all temporary inlet protection, cleaning of all permanent inlet protection, and cleaning of all inlets (existing downstream inlets and newly installed) of accumulated construction debris and sediment.
- D. Grates of Highway grate and Open Mouth Grate Inlets shall be protected using inlet filter bags as specified herein.
- E. Mouth of Open Mouth Grate Inlets and open mouth inlets (city inlets) shall be protected with a compost sock or synthetic filter as specified herein.
- F. During pipe laying work, prevent silt from entering the piping systems by use of hay bales, silt fence, temporary closures of pipe ends, or other means as best suited to the conditions.
- G. Inlet protection shall be installed, inspected, cleaned and replaced according to manufacturer's specifications.
 - 1. Inlet filter bags and open mouth inlet protection shall be removed and replaced when filled with silt or when extended periods of ponding occur following a precipitation event. New inlet filter bags or approved inlet protection devices shall be installed and secured immediately after removal of silted protection devices.

3.5 STORAGE STOCKPILES

- A. Stockpiles of all loose materials (aggregate, fill, soils, etc.) shall be protected from dust and rain by use of a cover. The cover shall be free of defects, and secured adequately to maintain protection of the materials. Owner/Authorized Representative reserves the right to refuse use of any material that has been compromised by inadequate protection onsite.

- B. Stockpiles shall not be placed upslope from any infiltration structure. Any drainage structure (such as but not exclusively inlets) downslope of a stockpile shall be adequately protected from runoff.
- C. Stockpile heights are not to exceed 20 feet. Stockpile slopes shall be 2:1 or flatter.
- D. Manage all excavated material stockpiled on the project site in compliance with PADEP fill management requirements (25 Pa. Code Chapters 271 and 287) as specified in Section 310000 – Earthwork, Articles 1.9.K through 1.9.O. Regulated fill shall not be stockpiled without prior authorization from PADEP.

3.6 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stabilize any disturbed area on which activity has ceased and which will remain exposed for more than five (5) days. This 5-day deadline is consistent with 25 Pa. Code Chapter 102 requirements.
 - 1. During non-germinating periods, apply mulch at recommended rates.
 - 2. Stabilize disturbed areas not at finished grade and that will be disturbed within one year in accordance with temporary seeding as specified on the Drawings and in the approved E&SPC Plan.
 - 3. Stabilize disturbed areas that are at finished grade or will not be disturbed within one year in accordance with Section 329200 – Lawn and Meadow.
- D. Final Stabilization: Final stabilization is achieved when:
 - 1. All earth disturbance activities are complete; and
 - 2. A uniform perennial vegetative cover with a density of 70% or greater has been established on all unpaved areas not covered by permanent structures; or an equivalent permanent stabilization measure (e.g., riprap, paving, mulch) has been applied; and
 - 3. All temporary E&S controls have been removed and the site is in a condition acceptable to the Owner/Engineer and, where applicable, PADEP.

3.7 CLEANING

- A. When sediment accumulation in sedimentation structures has reached one-third of the design depth, remove and dispose of sediment in accordance with all applicable regulations.
- B. Do not damage structure or device during cleaning operations.
- C. Do not permit sediment to erode into construction or site areas or natural waterways.
- D. Clean channels when depth of sediment reaches approximately one-half channel depth

3.8 REMOVAL AND FINAL CLEANUP

- A. Once the site has achieved final stabilization as defined in Article 3.6.D and approval has been given by Owner/Authorized Representative, all temporary erosion and sedimentation control measures and all accumulated silt and sediment shall be removed. All permanent inlet protection measures shall be cleaned, inspected, and verified to be in working order.

- B. Where NPDES CGP coverage was required, the Contractor shall provide written certification to the Owner/Engineer that final stabilization has been achieved, as required by Article 1.3.C.5, to enable submission of the NPDES NOT to PADEP.
- C. Any remaining dirt or debris within the public right of way shall be removed by the Contractor using necessary means sufficient to remove the dirt and debris from the public right of way. This may include, but is not limited to, street sweeping, sidewalk vacuuming, inlet cleaning, power washing, or hand removal.
- D. Silt and waste materials shall be disposed of in a proper manner in compliance with applicable PADEP regulations. No extra construction materials are to remain on-site upon completion of the Work. The Work of this Contract shall not be considered complete until all extraneous construction-related items have been removed (temporary traffic control devices, signage, etc.).

END OF SECTION 312500

SECTION 315000 – EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Work under this Section includes all labor, materials, equipment, and supervision necessary for the design, installation, maintenance, and removal (or approved permanent leaving-in-place) of excavation support and protection systems. Work includes, but is not limited to:
 - 1. Soil classification by a Competent Person in accordance with OSHA 29 CFR 1926 Subpart P, Appendix B.
 - 2. Sloped and benched excavation wall systems.
 - 3. Timber shoring systems.
 - 4. Aluminum hydraulic shoring systems.
 - 5. Steel trench shields (trench boxes) and other shield systems.
 - 6. Sheet pile and other engineered support systems.
 - 7. Daily inspections, monitoring, and emergency response.
- B. This Section governs the design and installation of all excavation protective systems on this project. Section 312316.13 – Trenching governs trench preparation, backfilling, and compaction.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 310000 – Earthwork: Fill classification, compaction standards, PADEP fill management, and utility locating.
 - 2. Section 311000 – Site Clearing.
 - 3. Section 312200 – Grading.
 - 4. Section 312316.13 – Trenching: Trench excavation procedures, backfilling, and compaction.
 - 5. Section 329110 – Green Stormwater Infrastructure Soils: Special requirements for sheeting and shoring removal within infiltration basin footprints.

1.3 REFERENCE STANDARDS

- A. Federal Occupational Safety and Health Administration (OSHA):
 - 1. 29 CFR 1926 Subpart P – Excavations (including Appendices A through F). [GOVERNING STANDARD]
 - 2. 29 CFR 1926 Subpart C – General Safety and Health Provisions.
 - 3. 29 CFR 1926 Subpart Q – Concrete and Masonry Construction (for concrete structures adjacent to excavations).
- B. ASTM International (latest editions):
 - 1. ASTM C131 – Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 2. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
 - 3. ASTM C535 – Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 4. ASTM D653 – Standard Terminology Relating to Soil, Rock, and Contained Fluids.
 - 5. ASTM D1140 – Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing.
 - 6. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - 7. ASTM D2216 – Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

8. ASTM D2487 – Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 9. ASTM D4253 – Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 10. ASTM D4254 – Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 11. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 12. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- C. AASHTO:
1. AASHTO T180 – Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop.
- D. Commonwealth of Pennsylvania:
1. Pennsylvania Underground Utility Line Protection Law, Act 287 of 1974, as amended by Act 50 of 2017.
 2. PADEP Chapter 102 – Erosion and Sediment Pollution Control.
 3. PADEP Policy on Management of Fill (25 Pa. Code Chapters 271 and 287).
- E. City of Philadelphia:
1. Philadelphia Water Department Standard Specifications and Standard Details (most recent revision).
- F. Philadelphia Parks and Recreation (PPR):
1. PPR Design and Construction Standards (January 2019, Updated May 2025), Division 31 Outline Specifications.
- 1.4 DEFINITIONS
- A. Competent Person: As defined in OSHA 29 CFR 1926.650 — one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
 - B. Registered Professional Engineer (PE): A Professional Engineer licensed in the Commonwealth of Pennsylvania, as required for design of protective systems not covered by the OSHA Appendix tables.
 - C. Excavation: Any man-made cut, cavity, trench, or depression in the earth surface formed by earth removal.
 - D. Protective System: A method of protecting employees from cave-ins, from material that could fall or roll into an excavation, or from the collapse of adjacent structures. Includes sloping and benching systems, support systems, shield systems, and other systems providing the necessary protection.
 - E. Soil Classification: The categorization of in-place soils as Type A, Type B, or Type C per OSHA 29 CFR 1926 Subpart P, Appendix B, based on visual and manual tests performed by the Competent Person.
 - F. Sloping: A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins.
 - G. Shoring: A structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.
 - H. Shield (Trench Box): A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure.
 - I. Subgrade: The lowest elevation of excavation or the highest elevation of embankment required to accommodate the indicated construction.
 - J. Backfill: Soil or soil-rock material used to refill excavations.

- K. Unsuitable Material: Excavated material or material below the natural ground surface that is unsuitable for its planned use.
- L. Optimum Moisture Content: The water content at which a soil can be compacted to its maximum dry unit weight by a given compactive effort.

1.5 SUBMITTALS

- A. Excavation Protection Plan: Not less than 10 business days before commencing excavation Work, submit an Excavation Protection Plan for Owner/Engineer review. The Plan shall be prepared under the direct supervision of the designated Competent Person and, where a PE-designed system is required, signed and sealed by a Registered Professional Engineer licensed in Pennsylvania. The Plan shall include:
 - 1. Name, qualifications, and OSHA training documentation for the designated Competent Person.
 - 2. Name, license number, and seal of the Registered Professional Engineer of record, where applicable.
 - 3. Anticipated soil types at the project site and methodology for field soil classification (OSHA Appendix B tests to be used).
 - 4. Proposed protective system type(s) for each distinct excavation or trench, with design basis and governing OSHA appendix table or PE design.
 - 5. Drawings or sketches showing maximum excavation dimensions, side slopes or shoring layout, surcharge setback distances, and access/egress locations.
 - 6. Water control and dewatering plan.
 - 7. Emergency response procedures, including evacuation plan and emergency contact list.
- B. PE-Designed Systems: Where a protective system requires design by a Registered Professional Engineer, submit signed and sealed design drawings and calculations prior to installation.
- C. Product Data: Submit manufacturer product data sheets for all prefabricated shoring components (hydraulic shores, trench boxes, slide-rail systems, etc.).
- D. Inspection Records: Maintain daily Competent Person inspection records on-site and make available to Owner/Engineer and OSHA upon request.
- E. Samples: Furnish and deliver samples of fill and backfill materials as selected by the Owner/Engineer.

1.6 PERFORMANCE REQUIREMENTS

- A. Hazardous Materials: If hazardous waste materials are discovered on the site, the Contractor shall immediately cease operations in the affected area and notify the Owner/Engineer and appropriate regulatory authorities. Work shall not resume in that area until authorized by the Owner/Engineer and, if required, PADEP. See Section 310000 – Earthwork, Article 1.9.K for requirements regarding evaluation of on-site soils for contamination.
- B. Tolerances:
 - 1. Finished subgrades: plus 0 inches, minus ½ inch of the elevation indicated.
 - 2. Finished grade of slopes (not steeper than 3H:1V): plus or minus ½ inch.
 - 3. Finished grade of slopes (steeper than 3H:1V): plus or minus 2 inches. Slopes shall not encroach upon roadbeds.
 - 4. Moisture content of fill during placement: within plus or minus 3 percent of optimum moisture content.
- C. Protect all existing and new construction, including utilities, finishes, and equipment, from water, damage, weakening, or other disturbance throughout all excavation and backfill operations.

1.7 PROJECT CONDITIONS

- A. Protection of Public and Adjacent Property:

1. Provide all necessary barricades, signs, lights, and other safety measures to prevent accidents and protect the public, the Work, and adjacent property at all times, including Saturdays, Sundays, and holidays.
 2. Contractor is responsible for all damages arising from neglect in providing proper protection.
- B. Parking and Storage: Confine parking of vehicles and storage of materials to designated areas approved by the Owner.
- C. Dust Control: Conduct operations and maintain the work area to minimize creation and dispersion of dust. Use wet-cutting methods for cutting concrete, asphalt, and masonry.
- 1.8 ENVIRONMENTAL REQUIREMENTS
- A. Do not perform excavating, filling, backfilling, or grading during weather conditions that could damage existing ground, in-progress work, or completed work.
- B. When work is interrupted by rain, do not resume until the site is suitable. Subgrade shall be free from mud, snow, ice, and deleterious material before work resumes.
- C. Protect excavation bottoms against freezing when atmospheric temperature is below 35 degrees Fahrenheit.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

- A. Material suitable for use as fill and backfill shall conform to the requirements of Section 310000 – Earthwork, Articles 2.1 and 2.2. Excavated on-site soils shall be evaluated for suitability prior to reuse. Unsuitable material shall be removed and disposed of off-site in accordance with all applicable regulations, including PADEP fill management requirements in 25 Pa. Code Chapters 271 and 287.
- B. Suitable excavated material shall be conditioned for reuse: spread in layers not exceeding 8 inches, raked free of debris and rubble, with rocks exceeding 4 inches in largest dimension removed. This 8-inch conditioning lift thickness applies to stockpile preparation; lift thicknesses for compaction are governed by Section 310000 – Earthwork.

2.2 SHORING AND SHIELD SYSTEM MATERIALS

- A. Timber Shoring: Sound, structural-grade lumber free of large knots, splits, and decay. Comply with OSHA 29 CFR 1926 Subpart P, Appendix C (Timber Shoring for Trenches) tables.
- B. Aluminum Hydraulic Shoring: Prefabricated aluminum hydraulic shoring systems listed by a Nationally Recognized Testing Laboratory (NRTL) or manufactured to the requirements of OSHA 29 CFR 1926 Subpart P, Appendix D. Provide manufacturer documentation confirming compliance.
- C. Trench Shields (Trench Boxes): Prefabricated steel or aluminum trench shields. Provide manufacturer data confirming shield dimensions, weight ratings, and applicable trench depth and width ranges. Shields shall be used in accordance with the manufacturer instructions.
- D. Sheet Piling: Steel sheet piling of structural grades appropriate for the applied loads, as designed by the Registered Professional Engineer of record.
- E. All shoring and shielding materials shall be in good serviceable condition. Damaged, cracked, or deformed components shall not be used.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES

- A. Contact the Pennsylvania One Call System (811) as required by Section 312316.13, Article 1.5, and Pennsylvania Act 287 (as amended by Act 50 of 2017), before commencing any excavation.
- B. Verify on-site the location and depth (elevation) of all existing utilities and services before performing any excavation work. Excavation within 3 feet of any utility line shall be performed by hand tools only.

- C. If water, gas pipes, conduits, or other utilities are broken or damaged during prosecution of the Work, immediately stop work and notify the Owner/Engineer and the appropriate utility authority. Contractor is responsible for all damages caused by such breaks.

3.2 SOIL CLASSIFICATION

- A. Before workers enter any excavation, the Competent Person shall classify the in-place soils at the excavation using the visual and manual tests described in OSHA 29 CFR 1926 Subpart P, Appendix B. Tests shall be performed on freshly exposed soil at the depth and location of the excavation.
- B. Soil Classification Categories (OSHA Appendix B):
 - 1. Type A — Cohesive soils with unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. Clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam qualify as Type A. Type A soils are not fissured, not subject to vibration, and not previously disturbed.
 - 2. Type B — Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf; granular cohesionless soils including angular gravel, silt, silt loam, sandy loam, and in some cases silty clay loam and sandy clay loam; fissured Type A soils; soils subject to vibration; and soils from which water is freely seeping.
 - 3. Type C — Cohesive soils with unconfined compressive strength of 0.5 tsf or less; granular soils including gravel, sand, and loamy sand; submerged soils; soils in a sloped, layered system where layers dip into the excavation; and soils subject to hydrostatic pressure.
- C. Previously disturbed soils (including urban fill, demolition debris, and regraded areas) shall be classified as no more favorable than Type B unless the Competent Person performs specific tests demonstrating a more favorable classification is appropriate.
- D. Field tests to be performed as applicable:
 - 1. Thumb penetration test: Type A soils are indented by the thumb with great effort; Type B soils can be penetrated with moderate effort; Type C soils can be easily penetrated.
 - 2. Pocket penetrometer or Torvane shear device, recording readings at the level of the excavation.
 - 3. Plasticity test (ribbon test): cohesive soils can be molded into a thread 1/8 inch in diameter without crumbling.
 - 4. Dry strength test: Type C dry specimens crumble easily; Type A dry specimens have significant resistance.
 - 5. Visual observation for fissuring, layering, water seepage, and prior disturbance.
- E. Document the soil classification and basis (tests performed, results) in the daily Competent Person inspection record before workers enter the excavation.
- F. Reclassify soils whenever conditions change (e.g., weather, dewatering, vibration from nearby equipment or traffic).

Protective System Selection Matrix (OSHA Subpart P — Trenches up to 20 feet deep)

Soil Type / Condition	Required Protective System (OSHA Subpart P)
Type A (< 12 ft deep)	Sloping at max $\frac{3}{4}$ H:1V, OR timber/hydraulic shoring per OSHA Appendix C/D, OR trench shield.
Type A (12–20 ft deep)	Sloping at max $\frac{3}{4}$ H:1V, OR PE-designed support system, OR trench shield rated for depth.
Type B (any depth)	Sloping at max 1H:1V, OR timber/hydraulic shoring per OSHA Appendix C/D, OR trench shield.
Type C (any depth)	Sloping at max $1\frac{1}{2}$ H:1V, OR timber/hydraulic shoring per OSHA Appendix C/D, OR trench shield.
Layered soils	Use most restrictive (least favorable) classification present. Consult PE if in doubt.
Exceeds 20 ft deep	PE-designed system required for all soil types. Tabulated data does not apply.

3.3 EXCAVATION

A. General

- Excavation shall be made to the grades shown on the Contract Drawings. Where excavation grades are not shown, excavate as required to accommodate installation of all indicated facilities.
- No worker shall enter any excavation until the Competent Person has classified the soil, selected the appropriate protective system, and either confirmed that the protective system is in place and adequate or confirmed that the excavation is sufficiently shallow and in sufficiently stable Type A soil that no protective system is required.

B. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is below 35 degrees Fahrenheit.

C. Stability of Excavations:

- Slope sides of excavation in accordance with the soil classification determined under Article 3.2 and the maximum slope ratios in the Protective System Selection Matrix above.
- Where sloping is not possible due to space constraints, soil conditions, proximity to structures, or other site conditions, provide shoring or trench shields as specified herein.
- Maintain sides and slopes of excavations in safe condition until completion of backfilling.

D. Shoring and Bracing Installation:

- Provide shoring and bracing materials in good serviceable condition. Install in accordance with the manufacturer instructions, OSHA Appendix C or D tables, or PE-sealed design, as applicable.
- Establish requirements for trench shoring and bracing based on soil classification, excavation dimensions, and surcharge loads, in compliance with OSHA 29 CFR 1926 Subpart P.
- Maintain shoring and bracing throughout the excavation period. Carry shoring down as excavation progresses. Do not remove shoring until backfill has been placed and compacted to a height adequate to provide equivalent support.
- Sheeting and shoring within or immediately adjacent to infiltration basin footprints shall be fully removed to avoid interference with infiltration performance. Refer to Section 329110 – Green Stormwater Infrastructure Soils and the Drawings.
- Where sheeting and shoring is designed to remain in place as part of the completed Work, cut off a minimum 18 inches below finished grade, unless otherwise directed by the Owner/Engineer.

E. Material Storage

1. Keep all stockpiled spoil and equipment at least 2 feet from the edge of all open excavations.
2. Locate and retain stockpiled materials in designated areas as directed by Owner/Engineer.

3.4 ATMOSPHERIC TESTING AND VENTILATION

- A. The Competent Person shall test all excavations deeper than 4 feet for atmospheric hazards before workers enter and as conditions warrant, where atmospheric hazards could reasonably exist. Test for:
 1. Oxygen deficiency or enrichment (acceptable range: 19.5% to 23.5% by volume).
 2. Flammable gas or vapors (acceptable level: below 10% of the lower explosive limit, LEL).
 3. Toxic gases or vapors (acceptable levels per OSHA permissible exposure limits, 29 CFR 1926.55).
- B. Testing shall be performed using calibrated instruments appropriate for the hazard.
- C. Where atmospheric hazards exist or may exist, provide and maintain adequate ventilation before and during worker occupancy of the excavation.
- D. Workers shall not enter excavations in which atmospheric hazards exist or may exist unless the Competent Person has determined that the hazard has been controlled.

3.5 WATER ACCUMULATION

- A. Do not permit workers to enter excavations in which water has accumulated or is accumulating, unless adequate precautions are taken to protect them from cave-in, collapse, or drowning.
- B. Precautions for water in excavations include:
 1. Removal of accumulated water using a sump pump or vacuum pump before workers enter; the Competent Person must verify water removal is complete and the excavation bottom is stable.
 2. Continuous dewatering during worker occupancy where inflow rate warrants.
 3. Inspection by the Competent Person after dewatering to confirm that soil stability has not been compromised by saturation.
- C. Where surface water or rainwater could enter the excavation, provide interceptor ditches, dikes, or other drainage measures to prevent water entry.
- D. Conduct dewatering operations in compliance with applicable PADEP and Philadelphia Water Department stormwater and discharge permit requirements.

3.6 DAILY INSPECTION AND EMERGENCY RESPONSE

- A. Daily Inspections (OSHA 29 CFR 1926.651(k)):
 1. The Competent Person shall inspect all open excavations, adjacent areas, and protective systems:
 - a. Before workers enter the excavation at the beginning of each work shift.
 - b. After every rainstorm, freeze-thaw event, vibration occurrence, or other potentially hazard-increasing event.
 - c. As needed throughout the work shift.
 2. Document each inspection in a written log, including: date, time, Competent Person name, soil conditions, protective system condition, any changed conditions, and corrective actions taken or ordered. Retain logs at the project site and provide to Owner/Engineer upon request.
- B. Evacuation and Re-Entry:
 1. The Competent Person is authorized and required to order the immediate evacuation of all workers from any excavation in which a hazardous condition is identified.

2. Workers shall not re-enter the excavation until the Competent Person has assessed and resolved the hazard and documented the corrective action.
- C. Emergency Response:
1. Maintain an emergency response plan on-site. The plan shall include emergency contact numbers (Owner/Engineer, utility companies, Philadelphia Fire Department, and local EMS), evacuation routes, and rescue procedures.
 2. Provide rescue equipment appropriate for excavation emergencies (e.g., safety harness, lifeline, breathing apparatus) where hazardous atmospheric conditions exist or could develop.
- 3.7 BACKFILL
- A. Backfill excavations promptly as Work permits, but not before:
1. All required waterproofing membranes or coatings are applied and cured, if applicable.
 2. All inspections required by the Owner/Engineer, Philadelphia Water Department, or other authorities having jurisdiction are completed and approved.
- B. Placement and Compaction:
1. Place backfill in layers not more than 4 inches in loose depth in confined areas adjacent to structures using hand-operated tampers. For all other backfill, comply with Section 310000 – Earthwork for lift thickness and compaction requirements.
 2. Place backfill and fill materials evenly adjacent to structures. Carry material uniformly around structures to approximately the same elevation at each lift to prevent unequal lateral loading.
- 3.8 GRADING
- A. Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
- B. All grading shall conform to the requirements of Section 312200 – Grading and Section 310000 – Earthwork, including PPR minimum and maximum slope requirements, ADA-compliant grades on accessible routes, and finish grading standards.
- 3.9 CLEAN-UP
- A. Upon completion of the Work of this Section, remove all excess excavation material, rubbish, trash, and debris from the site. Dispose of legally off-site in accordance with Section 310000 – Earthwork, and all applicable local, state, and federal regulations, including PADEP fill management requirements (25 Pa. Code Chapters 271 and 287).
- B. Leave the site in a neat and orderly condition satisfactory to the Owner/Engineer.

END OF SECTION 31 50 00

SECTION 321116 – SUBBASE COURSE

PART 1 - GENERAL

1.1 SUMMARY

- A. This item consists of the preparation of the subgrade and the construction of a layer of aggregate for driveways, footways/sidewalks, and roadway pavement of the depth indicated, to the lines and grades shown on the drawings, or as directed by the engineer.
- B. Section Includes:
 - 1. Aggregate subbase.
 - 2. Aggregate base course.
- C. Related Sections:
 - 1. 310000 - Earthwork
 - 2. 321600 - Concrete Sidewalk

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
- B. ASTM International:
 - 1. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
 - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit data for geotextile fabric.
- C. Samples: Submit, in air-tight containers, 10 lb. sample of each type of aggregate fill to testing laboratory.
- D. Materials Source: Submit name of aggregate materials suppliers.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work according to Pennsylvania Department of Transportation standards.
- C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Subbase Aggregate and Base Course Aggregate:
 - 1. No. 2A Stone Aggregate in accordance with PennDOT Publication 408, Section 703.

2.2 ACCESSORIES

- A. Geotextile Fabric:
 - 1. Class 4, Type C Woven Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.

PART 3 - EXECUTION

3.1 GENERAL

- A. Subbase material shall not be placed on soft, muddy or frozen areas, nor until all irregularities in the prepared areas, including soft areas in the foundation, have been satisfactorily corrected. The subgrade shall be compacted to not less than the minimum densities required by Section 310000 – Earthwork, Article 3.2 (95% per ASTM D1557 for walkways and utility trenches; 98% per ASTM D698 for pavements and wall backfill).
- B. Unstable subbase conditions, including soft foundation areas which develop ahead of the base and paving operations shall be satisfactorily corrected by scarifying, reshaping, and compacting, or by replacement as required.

3.2 PLACEMENT

- A. Install geotextile fabric over subgrade as indicated on the plans and in accordance with manufacturer's instructions.
 - 1. Lap ends and edges minimum 6 inches.
 - 2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.
- B. Place aggregate in equal thickness layers over prepared substrate to total compacted thickness indicated on Drawings.
 - 1. Maximum Layer Compacted Thickness: 6 inches
 - 2. Minimum Layer Compacted Thickness: 3 inches
- C. Level and contour surfaces to elevations, profiles, and gradients indicated.
- D. Add small quantities of fine aggregate to course aggregate when required to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain specified compaction density.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. When constructed in part width, the extension of the subbase construction shall not proceed to its full width until the existing edge of the subbase is trimmed and all foreign and deleterious material is removed from the remaining prepared area.

3.3 COMPACTION

- A. The uniformly spread material shall be compacted by means of approved equipment to not less than one hundred percent (100%) of the maximum dry weight density (PENNSYLVANIA TEST METHODS (PTM) No. 106, Method B) as determined by PTM No. 112, or PTM No. 402. When the material is too coarse to satisfactorily use these methods, compaction will be determined by the Engineer based on non-movement of the material under the specified compaction equipment. Compaction shall progress gradually from the sides to the center with each succeeding pass uniformly overlapping the previous pass, and shall continue until the entire area is satisfactorily shaped and compacted to the required lines and grades. One (1) density determination shall be made for each three thousand (3,000) square yards or less, on each layer of completed subbase.

3.4 DEPTH TEST

- A. The depth of the finished subbase will be determined by cutting or digging holes to the full depth of the completed subbase. One depth measurement shall be made for each three thousand (3,000) square yards, or less, of the completed subbase. Any section in which the subbase is one half inch (1/2") or more deficient in specified depth shall be scarified to a depth of at least three inches (3"), blended with the necessary additional material, and then recompact to the specified density and depth or otherwise satisfactorily corrected.
- B. All test holes shall be cut or dug, backfilled with similar material, and satisfactorily compacted by and at the expense of the Contractor. This operation shall be under the direct supervision of the inspector who will check the depth for record purposes.

3.5 MAINTENANCE OF TRAFFIC

- A. No traffic shall be allowed on the completed subbase other than necessary local traffic and that developing from the operation of essential construction equipment, unless otherwise directed by the Engineer. Any defects which may develop in the construction of the subbase or any damage caused by the operation of local or job traffic is the responsibility of the Contractor and shall be immediately repaired or replaced at the expense of the Contractor.
- B. The completed subbase shall be uniformly moistened immediately prior to the construction of the base course and/or pavement, except where concrete pavement or concrete sidewalk is to be placed. This requirement does not apply when a hot-mix bituminous base course is to be placed.
- C. Completed subbase which has been subjected to hauling or exposed to the elements for periods in excess of one-hundred-twenty (120) calendar days will require re-testing of the material and re-approval by the Engineer before construction of the base course or pavement may proceed. Subbase so used or exposed, not meeting the requirements herein specified shall be reconstructed or replaced as directed by the Engineer at the expense of the Contractor.

END OF SECTION 321116

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SECTION 321216 – ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes all labor, equipment, and materials necessary for the installation and testing of Warm Mix Asphalt Superpave Wearing Course, Warm Mix Asphalt Superpave Binder Course, and Warm Mix Asphalt Superpave Base Course of specified depths.
- B. Section Includes:
 - 1. Asphalt paving base course, binder course, and wearing course.
- C. For bituminous asphalt paving in public right-of-way. Refer to the City of Philadelphia, Department of Streets, Standard Construction Items for materials, equipment, installation, and testing requirements.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 310000 - Earthwork
 - 2. Section 321116 - Subbase Course

1.3 REFERENCES

- A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. Pennsylvania Department of Transportation (PennDOT), Publication 408/2020
 - 2. PennDOT Bulletin No. 15: Qualified Products List for Construction
 - 3. Asphalt Institute (AI): "The Asphalt Handbook"
 - 4. Philadelphia Parks and Recreation (PPR), Division 32 Outline Specifications – Section 321216 Asphalt Paving (current version).
 - 5. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):
 - a. ASTM D 692 - Coarse Aggregate for Bituminous Paving Mixtures
 - b. ASTM D 979 - Sampling Bituminous Paving Mixtures
 - c. ASTM D 1073 - Fine Aggregate for Asphalt Paving Mixtures
 - d. ASTM D 1188 - Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
 - e. ASTM D 2041 - Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures
 - f. ASTM D 2726 - Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
 - g. ASTM D 2950 - Density of Bituminous Concrete in Place by Nuclear Methods
 - h. ASTM D 3549 - Thickness or Height of Compacted Asphalt Mixture Specimens
 - i. ASTM D 3666 - Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
- B. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated on the Drawings or within these specifications.
 - 1. City of Philadelphia, Department of Streets: Standard Construction Items, except that measurement and payment sections do not apply.

2. Publication 408: Specifications, except that measurement and payment sections do not apply.

1.4 SUBMITTALS

- A. Product Data: For each product specified. Include technical data and tested physical and performance properties.
- B. Job-Mix Design: Certification, by PennDOT and other authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- D. Material Test Reports: Test Reports shall be from the approved testing agency. Indicate and interpret test results for compliance of materials with requirements indicated.
- E. Material Certificates: Certificates signed by manufacturers certifying that each material complies with the requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed warm-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing warm-mix asphalt similar to that indicated for this project and with a record of successful in-service performance.
 1. Firm shall be a registered and approved paving mix manufacturer listed in PennDOT Bulletin No. 15.
- C. Testing Agency Qualifications: Demonstrate to the Owner's satisfaction, based on Owner's evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- D. Obtain materials from the same source throughout the project.
- E. Pre-construction conference: Conduct conference at the project site to comply with the requirements of Division 1 sections and to review the methods and procedures related to asphalt paving including but not limited to the following:
 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture warm-mix asphalt.
 2. Review condition of substrate and preparatory work performed by other trades.
 3. Review requirements for protecting paving work, including restriction of traffic during installation period for remainder of construction period.
 4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving installer's personnel, and equipment required to execute the work without delays.
 5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
 6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.6 REGULATORY REQUIREMENTS

- A. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Asphalt Base Course: Minimum air or surface temperature of 35 deg F at time of placement in accordance with PennDOT Publication 408, Section 313.3(b).
 - 2. Asphalt Wearing Course: Minimum air or surface temperature of 40 deg F at time of placement in accordance with PennDOT Publication 408, Section 413.3(b).

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Aggregates shall be in accordance with the latest version of PennDOT Publication 408, Section 413.2(b). Provide aggregate from sources listed in PennDOT Bulletin 14.

2.2 ASPHALT MATERIALS

- A. Asphalt Cement: PG-64-22 emulsion in accordance with PennDOT Publication 408, Section 413.2(a)1.
 - 1. Water: Potable
 - 2. Mix designs shall contain a maximum of 15% reclaimed asphalt pavement.
- B. AUXILIARY MATERIALS
 - 1. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA) and PADEP. Provide granular, liquid, or wettable powder form.
 - 2. Sand: Type B in accordance with PennDOT Publication 408, Section 703.
 - 3. Joint Sealant: ASTM D 3405 or AASHTO M 301, hot applied, single component, polymer-modified bituminous sealant.
 - 4. Geotextile: Class 4, Type A Non-Woven Needle Punched Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.
- C. MIXES
 - 1. Warm-mix Asphalt: Provide dense, hot-laid, warm mix asphalt plant mixes approved by PennDOT and complying with the following requirements. Where PPR requires PennDOT ID-2 mixes shall be used unless Superpave WMA is approved in writing by PPR as an acceptable substitute prior to construction.
 - a. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - b. Superpave Base Course: Superpave Asphalt Mixture Design, WMA Base Course, PG 64-22, 3 to <10 Million ESALs, 25 mm Mix, in accordance with PennDOT Publication 408, Section 313. Minimum thickness per PPR standards; Walkways/Trails – not applicable to base course; Drive Aisles/Parking – 2.5 inch binder + 1.5 inch wearing = 4 inches total. Refer to drawings for project specific thicknesses.
 - c. Superpave Binder Course: Superpave Asphalt Mixture Design, WMA Binder Course, PG 64-22, 3 to < 10 Million ESALs, 19 mm Mix, in accordance with PennDOT Publication 408, Section 413. PPR minimum binder course thickness; 2 inches for walkways/trails; 2.5 inches for drive aisles, parking, and sports courts.
 - d. Superpave Wearing Course: Superpave Asphalt Mixture Design, WMA Wearing Course, PG 64-22, 3 to < 10 Million ESALs, 9.5 mm Mix, in accordance with PennDOT Publication 408, Section 413. PPR minimum wearing course thickness; 1.5 inches for all paving categories.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Refer to Section 321116 for subbase preparation requirements. Refer to Section 321136 for Concrete Base Course Preparation.
- C. Verify gradients and elevations of subbase or base are correct.
- D. Asphalt paving courses shall be installed in accordance with PennDOT Publication 408, Section 413.
- E. Protect adjacent work and structures from splashing of paving materials.

3.2 CONDITIONING OF EXISTING SURFACE

- A. The vertical surface of curbs, structures, gutters, and existing paving in contact with bituminous mixtures, shall be painted with a uniform coating of bituminous material of the class and type designated for the surface course.

3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subbase or base is ready to receive paving.
 - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted aggregate base before applying paving materials.
 - 1. Apply herbicide only if absolutely necessary. Owner approval in writing is required prior to any herbicide application. Herbicide application must comply with all federal, state and local regulations.
- C. Adjust elevation of existing utility structure tops to remain, including but not limited to manholes, inlet grates, valve boxes, etc. to final grades. Depending on the type of utility structure, adjustment shall be accomplished by the installation of factory-fabricated adjustment rings, installation of additional masonry courses under existing manhole castings or inlet tops, or resetting structures. Coordinate with utility owners prior to disturbing existing underground utilities to remain.
- D. At existing curbs to remain, mill existing pavement as required to maintain existing curb reveal unless otherwise noted on the Drawings.

3.4 DEMOLITION

- A. Saw cut and notch existing paving as indicated on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.5 WARM-MIX ASPHALT PLACING

- A. Machine place warm-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and compacted thickness as indicated on the Drawings.

1. Place warm-mix asphalt base course in a single lift and thickness indicated on the Drawings or within these specifications.
 2. Place warm-mix asphalt binder course in a single lift and thickness indicated on the Drawings or within these specifications.
 3. Place warm-mix asphalt wearing surface course in single lift and thickness indicated on the Drawings or within these specifications.
 4. Spread mix at minimum temperature as indicated in PennDOT Publication 408, Section 413.
 5. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated on the Drawings or within these specifications.
- B. Place paving in consecutive strips not less than 10 feet wide, except where infill edge strips of a lesser width are required. After the first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt binder course for a section before placing asphalt wearing surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with warm-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of warm-mix asphalt course.
1. Clean contact surfaces and apply tack coat.
 2. Offset longitudinal joints in successive courses a minimum of 6 inches, however, the joint at the top layer shall be at the centerline of the roadway for 2-lane roads, and at the lane lines for roads with more than two lanes.
 3. Offset transverse joints in successive courses a minimum of 24 inches.
 4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook".
 5. Compact joints as soon as warm-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.
- B. Apply bituminous material of the class and type designated for the surface course where new pavement meets existing bituminous pavement, and where bituminous pavement meets curbs and utility structures. Apply sealant in layer thickness that provides for curing and will not cause tracking or lifting of sealant to other surfaces. Apply a fine sand covering temporarily over sealant during curing period.

3.7 PAVEMENT COMPACTION

- A. When the subgrade is exposed proof roll according to the requirements shown. Densify to a stable subgrade. Subgrade shall be compacted to a minimum of 95% Standard Proctor per ASTM D698 in accordance with PPR requirements and Section 310000 – Earthwork, Article 3.2. If the Owner determines that the subgrade cannot be densified to a stable condition, then the Owner may direct the Contractor to remove additional subgrade material to the depth required for a stable condition. The Contractor shall then replace unstable subgrade material with 2A stone compacted in 6-inch loose lifts.
- B. Begin new pavement compaction as soon as placed warm-mix paving will bear roller weight without excessive displacement. Compact warm-mix paving with hot, hand tampers, or vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 F.

- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with warm-mix asphalt, and rerolling to required elevations.
- D. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while warm-mix asphalt is still hot enough to achieve specified density. Continue rolling until warm-mix asphalt course has been uniformly compacted to the following density:
 - 1. Density: not less than 95 percent of the density requirements established by the Marshall method at the time of approval of the mix design.
- E. Finish Rolling: Finish roll paved surfaces to remove roller marks while warm-mix asphalt is still warm.
- F. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.
- G. Repairs: Remove newly paved areas that are defective or contaminated with foreign materials. Remove paving course over areas affected and replace with fresh, warm-mix asphalt. Compact by rolling to specified density and surface smoothness.
- H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated on the Drawings within the following tolerances:
 - 1. Base Course: Plus or minus $\frac{1}{4}$ inch. PPR minimum total thicknesses must be met after compaction; 3.5 inches for walkways/trails; 4 inches for drive aisles, parking, and sports courts.
 - 2. Binder Course: Plus or minus $\frac{1}{4}$ inch
 - 3. Wearing Surface Course: Plus $\frac{1}{4}$ inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10 foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: $\frac{1}{4}$ inch.
 - 2. Binder Course: $\frac{1}{4}$ inch
 - 3. Wearing Surface Course: $\frac{1}{8}$ inch.
 - 4. Crowned Surfaces: Test with crowned template centered at right angle to crown. Maximum allowable variance from template is 0.25 inch.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: As part of this contract, the Contractor shall engage a qualified independent testing agency meeting the requirements of paragraph 1.06 to perform field inspections and test and to prepare test reports.
 - 1. Testing agency shall conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing, at Contractor's sole expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness: In-place compacted thickness of warm-mix asphalt courses will be determined according to ASTM D3549.

- D. Surface Smoothness: Finished surface of warm-mix asphalt will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by the testing agency according to ASTM D 979.
 - 1. Reference laboratory density shall be determined by averaging results from 4 samples of warm-mix asphalt-paving mixture delivered daily to site and compacted according to job-mix specifications.
 - 2. Reference maximum theoretical density shall be determined by averaging results from 4 samples of warm-mix asphalt paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 3. In-place density of compacted pavement shall be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - 4. One core sample shall be taken for every 1000 sq. yd. or less of installed pavement, but no case will fewer than 3 cores be taken.
 - a. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
 - b. The Contractor shall fill all holes from which cores were taken. Restore and seal the surface to conditions similar to the adjacent areas.
- F. Remove and replace or install additional warm-mix asphalt, at the Contractor's sole expense, where test results or measurements indicate that it does not comply with specified requirements.

3.10 CLEANUP

- A. Remove bituminous material from utility structure frames and covers. Open and reset utility manhole covers and inlet grates to ensure castings are not sealed shut.
- B. Clean up debris and unused material, and remove from the site. Dispose of all material in accordance with local, state, and federal regulations. Do not dump material in manholes or inlets.

END OF SECTION 321216

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SECTION 321400

UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Limestone exterior stair treads to replace existing original treads at front entrance.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For materials other than water and aggregates.
2. For the following:
 - a. Pavers.
 - b. Mortar and grout materials.
 - c. Edge restraints.

B. Samples: For each type of unit paver indicated.

1. Joint materials involving color selection.
2. Exposed edge restraints involving color selection.
3. Pavers.

1.3 LEED SUBMITTALS

A. LEED Environmental Reporting Form: For all installed products and materials of this Section, complete the "LEED Environmental Reporting Form" (attached to end of Section 018113 "Sustainable Design Requirements")

1. **Product Material Cost:** Provide the cost for material, or an assembled product, including taxes and delivery but excluding any cost for labor and equipment required for installation after the material is delivered to the site. Provide total cost (not unit cost) of each product. Estimated cost at time of submittal is permissible.
2. **Product Data for Credit - Environmental Product Declarations (EPD):** For all products that meet EPD requirements, EPDs with relevant sections highlighted.
3. **Product Data for Credit - Sourcing of Raw Materials:** For all products that meet Leadership Extraction Practices requirements, documentation demonstrating products meet at least one of the sustainable extraction criteria listed in the related credit Performance Requirements in Section 018113 "Sustainable Design Requirements," and product data sheet or letter from product manufacturer indicating extraction and manufacturing location and letter from product vendor indicating purchasing location.

Highlight relevant information.

- a. For bio-based products, manufacturer's documentation for all products meeting the Sustainable Agriculture Network's Sustainable Agriculture standard (e.g., Rainforest Alliance certification).
- b. For wood products, documentation of vendor chain-of-custody certificate numbers for all wood products with FSC certification.
- c. For reused materials, receipts for salvaged and reclaimed materials indicating sources and cost (actual cost or replacement value, whichever is higher).
- d. For recycled content products, manufacturer's documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content.

1.4 QUALITY ASSURANCE

A. Sustainability and LEED Standards:

- 1. ISO 14025, 14040, 14044, and EN 15804 or ISO 21930.
- 2. ASTM Test Method D6866 or equivalent method ISO 16620-2, or USDA BioPreferred Voluntary Labeling Initiative, including ASTM 6866 testing.
- 3. Sustainable Agriculture Network's Sustainable Agriculture Standard
- 4. Forest Stewardship Council (FSC)
- 5. California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", v1.2-2017
- 6. California Air Resources Board (CARB) 2007 Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products, Phase 2
- 7. South Coast Air Quality Management District (SCAQMD), Rule 1113, "Architectural Coatings", effective date of June 3, 2011

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- C. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.
 - 1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C67.

1.6 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or

frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Bituminous Setting Bed:

1. Install bituminous setting bed only when ambient temperature is above 40 deg F and when base is dry.
2. Apply asphalt adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when setting bed is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
 - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 STONE PAVERS

- A. Limestone Pavers: Rectangular paving slabs made from limestone complying with ASTM C568/C568M.
1. Classification: III High-Density.
 2. Stone Abrasion Resistance: Minimum value of 10, based on testing according to ASTM C241/C241M or ASTM C1353.
 3. Indiana Oolitic Limestone Grade and Color: Standard, buff, according to grade and color classification established by ILI.
 4. Finish: Chat sawed.
 5. Thickness: Match existing.
 6. Face Size: As indicated to match existing.

2.2 ACCESSORIES

- A. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.
- B. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.

2.3 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D2940/D2940M, subbase material.
- B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D2940/D2940M, base material.
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33/C33M for fine aggregate.
- D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D448 for Size No. 10.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
 - 1. Provide sand of color needed to produce required joint color.
- F. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
 - 3. Permittivity: 0.02 per second, minimum; ASTM D4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.
- G. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D4751.
 - 3. Permittivity: 0.5 per second, minimum; ASTM D4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install new stone stair treads in same manner and utilizing similar materials as existing tread installation.
- B. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- C. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

- D. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
1. For concrete pavers, a block splitter may be used.
- E. Joint Pattern: Match and continue existing unit paver joint pattern.
- F. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.
1. Provide joint filler at waterproofing that is turned up on vertical surfaces.
- G. Tolerances:
1. Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.
 2. Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- H. Expansion and Control Joints:
1. Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."
 2. Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.
- I. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
 2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge.
 3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."
 4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
 5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.
- J. Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.
1. Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

3.2 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D698 laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.
- D. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
- E. Place aggregate base, compact to 100 percent of ASTM D1557 maximum laboratory density, and screed to depth indicated.
- F. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.
- G. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- H. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- I. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.
 - 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- J. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
 - 1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches of uncompacted pavers adjacent to temporary edges.
 - 2. Before ending each day's work, compact installed concrete pavers except for 36-inch width of uncompacted pavers adjacent to temporary edges (laying faces).
 - 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches of laying face.
 - 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- K. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- L. Do not allow traffic on installed pavers until sand has been vibrated into joints.

- M. Repeat joint-filling process 30 days later.

3.3 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.
- C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D. Place reinforcing wire over concrete subbase, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of mortar bed. Hold edges back from vertical surfaces approximately 1/2 inch.
- E. Place mortar bed with reinforcing wire fully embedded in middle of mortar bed. Spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- F. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- G. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.
- H. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.
- I. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
- J. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/8 inch.
- K. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- L. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
 - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.
- M. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

END OF SECTION 321400

SECTION 321600 – CONCRETE SIDEWALKS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes all labor, equipment, and materials necessary for the installation of the following as specified on the Drawings:
 - 1. Sidewalk pavement on an aggregate subbase.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 310000 - Earthwork
 - 2. Section 321116 - Subbase Course

1.3 REFERENCES

- A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. Pennsylvania Department of Transportation (PennDOT), Publication 408/2020
 - 2. PennDOT Bulletin No. 14: Aggregate Producers
 - 3. PennDOT Bulletin No. 15: Qualified Products List for Construction
 - 4. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
 - 5. ACI 318 – Building Code Requirements for Reinforced Concrete
 - 6. PennDot RC-67M – Curb Ramp and Sidewalk Construction Details
 - 7. Philadelphia Parks and Recreation (PPR) Division 32 Outline Specifications (current version)

1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit required information regarding concrete materials, joint filler, admixtures, and curing compounds.
 - 2. Mix Design:
 - a. Submit concrete mix design for each concrete strength prior to commencement of Work.
Mix design shall be submitted to the Owner's Representative for approval. The Owner's Representative may reject the design mix for non-compliance with these specifications or PPR standards.
 - b. Submit separate designs if admixtures are required for hot- and cold-weather concrete Work.
 - c. Identify mix ingredients and proportions, including admixtures.

3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:

1. Submit qualifications for manufacturer and installer.

1.6 QUALITY ASSURANCE

- A. Perform Work according to PennDOT Publication 408, Section 704.
- B. Obtain cementitious materials from same source throughout.
- C. Maintain copies of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according with manufacturer's instructions.
- C. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 AGGREGATE SUBBASE

- A. As specified in Section 321116 - Subbase Course
- B. Minimum Aggregate Subbase Thickness:
 1. Pedestrian Walkways: 4 inches compacted crushed aggregate (PennDOT 2A Modified, 2B Clean Aggregate, AASHTO No. 57 Stone, or approved equal).
 2. Vehicular and Access Drives: 6 inches compacted crushed aggregate (PennDOT 2A Modified, 2B Clean Aggregate, AASHTO No. 57 Stone, or approved equal).

2.2 Concrete Mix

- A. Concrete: Minimum compressive strength shall be 4,000 psi at 28 days. Class A concrete per PennDOT Publication 408, Section 704 is acceptable provided it meets the 4,000 psi minimum.
- B. B. Admixtures: All concrete shall contain a water-reducing, plasticizing admixture or a high-range water-reducing (superplasticizer) admixture. All concrete shall contain an air-entraining admixture providing 5%–7% air entrainment. Maximum chloride content shall be 0.15%. Maximum water/cement ratio shall be 0.45. Maximum design slump shall be 3 inches without superplasticizers.

- C. Aggregate: Maximum aggregate size shall be 3/4 inch with a designation of 4S per ASTM C33.
- D. Reinforcing: PPR preference is for unreinforced concrete pavement to facilitate future repairs and replacements. Where reinforcing is required by site conditions or design, provide the following:
 - 1. Welded wire fabric shall be galvanized and comply with ASTM A185.
 - 2. Reinforcing steel bars shall be Grade 60 per ASTM A615.

2.3 CURING MATERIALS

- A. Cure: Moist curing is required for all concrete work. Commence moist curing as soon as finishes will not be marred. Use insulating blankets, waterproofed kraft paper, or polyethylene film per ASTM C171 to keep concrete continuously moist during the curing period. PennDOT Publication 408, Section 711.2(a) also applies.

2.4 JOINT MATERIAL

- A. Joint Material: PennDOT Publication 408, Section 705.1.
- B. Expansion Joints: Provide sealed/caulked expansion joints throughout.
- C. Control Joints: Provide control joints at spacing as required to prevent cracking within panels. Joints shall be tooled prior to broom finishing to eliminate window-pane appearance. Sawcut joints are not preferred; if sawcut joints are proposed, prior written approval shall be obtained from Philadelphia Parks and Recreation before proceeding.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify that gradients and elevations of subgrade are as indicated on Drawings.

3.2 SIDEWALK CONSTRUCTION

- A. In accordance with PennDOT Publication 408, Section 676.3 and PennDOT RC-67M. The thickness of the sidewalk paving and aggregate shall be as defined in the construction plans and shall meet or exceed the following PPR minimum thicknesses:
 - 1. Pedestrian Walkways: Minimum 4 inches thick concrete, unreinforced, on 4 inches compacted crushed aggregate subbase.
 - 2. Vehicular and Access Drives: Minimum 6 inches thick concrete on 6 inches compacted crushed aggregate subbase. Reinforcement and thickness shall be evaluated based on vehicle weights, axle loading, usage, and local soil conditions, and shall be increased above the minimum if conditions warrant. Designer shall provide final thickness.
 - 3. Driveway Aprons and Sidewalks within Rights of Way: Follow City of Philadelphia Department of Streets standards of construction.

3.3 FINISHING

- A. Finish shall be non-slip broom type finish.

- B. Joints shall be tooled prior to broom finishing to eliminate window-pane appearance. Sawcut joints require prior written approval from Philadelphia Parks and Recreation.

3.4 DRAINAGE

- A. Pavements shall have positive drainage off the surface. Provide a minimum cross pitch of 1.0% and a maximum cross pitch of 2.0%. Plaza areas shall have maximum grades of 2.0% in any direction.
- B. Grades on any pavement designated or intended to be accessible per the Americans with Disabilities Act (ADA) shall not exceed the grade maximums noted in the ADA or ADA Accessibility Guidelines (ADAAG).

3.5 TOLERANCES

- A. Surface tolerances shall be verified using a 10-foot unleveled straightedge resting on high spots:
 - 1. Longitudinal direction: Maximum gap of 1/8 inch.
 - 2. Transverse direction: Maximum gap of 1/4 inch.
 - 3. Ramps, sidewalks, and intersections in any direction: Maximum gap of 1/4 inch.
 - 4. ADA-accessible routes: Grades shall not exceed maximums required by the ADA and ADAAG in any case.

END OF SECTION 321600

SECTION 321723
PAVEMENT MARKINGS

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 furnishing and installation of custom thermoplastic pavement marking material into asphalt pavement.
- B. Related Requirements:
 - 1. Section 321216 "Asphalt Paving" for new asphalt pavement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Using electronic files provided by Landscape Architect of patterns, produce manufacturer drawings for review and approval prior to fabrication.
- C. Samples for Verification: For each color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Follow manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ennis-Flint™ by PPG, <https://www.ppg.com/traffic/en-US/products>. Contact: Chris Hoffman, choffman@ppg.com, (484) 836-8820
- B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Deco-Mark. Custom design, digital vector graphic file to be provided by Landscape Architect, colors to be selected from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin imprinting process according to manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING THERMOPLASTIC

- A. General: Install according to manufacturer's written instructions, using manufacturer's recommended equipment.

END OF SECTION 321723

SECTION 321816
PLAYGROUND PROTECTIVE SURFACING

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. Bonded poured-in-place rubber seamless surface.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for filling and grading and for drainage course drainage/separation geotextiles and subbase courses.

1.3 DEFINITIONS

- A. Critical Height: Standard measure of shock attenuation. According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."
- B. SBR: Styrene-butadiene rubber.

1.4 PERFORMANCE REQUIREMENTS

- A. Impact Attenuation: According to ASTM F 1292.
- B. Accessibility of Surface Systems: According to ASTM F 1951.
- C. US Consumer Product Safety Commission – Public Playground Safety Handbook No. 325.
- D. ASTM F2479 – Standard Guide for Specification, Purchase, Installation and Maintenance of Pured-In-Place Playground Surfacing.
- E. ASTM F2223 – Standard Guide for ASTM Standards on Playground Surfacing.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for verification: For each type of playground surface system indicated.

1. Minimum 6-by-6-inch Sample of safety pad.
 2. Minimum 6-by-6-inch Sample of geotextile.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Extent of surface systems and use zones for equipment.
 2. Critical heights for playground surfaces and fall heights for equipment.
- D. Qualification Data and Certification: For qualified Installer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each unitary synthetic playground surface system.
1. Impact/drop test per the requirements of ASTM F1292 to show conformance with the G-Max and HIC criteria listed above. Per ASTM F1292 the impact/drop test shall be performed at the most adverse location on the playground. The impact/drop test shall be conducted by a Certified Playground Safety Inspector (CPSI) who will prepare a certification report of the results. If the surface fails to meet the stated criteria the surface shall be corrected/removed and reinstalled.
- F. Field quality-control reports.
- G. Closeout Submittals - Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company specializing in the manufacture of products specified in this Section with minimum of three (3) years experience
- B. Installer Qualifications: Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with playground safety surface installation and construction techniques under the supervision of an experienced foreperson.
- C. Source Limitations: Obtain playground surface system materials from single source from single manufacturer.
- D. Provide secondary materials including geotextiles and repair materials of type and from source recommended by manufacturer of playground surface system materials.
- E. Standards and Guidelines: Comply with CPSC No. 325, "Handbook for Public Playground Safety"; ASTM F 1292; and ASTM F 1487.

1.7 PROJECT CONDITIONS

- A. Verify existing conditions in the field prior to start of work. Should Contractor, in the course of work, find any discrepancies between Drawings and physical conditions or any omissions or errors in Drawings, inform Owner immediately in writing for clarification. Work done after such discovery, unless authorized by Owner, shall be at Contractor's risk.

- B. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground surface system that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Reduction in impact attenuation.
 - b. Deterioration of surface and other materials beyond normal weathering.
 - c. Deterioration or failure of seams.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Proper drainage is critical to the longevity of the Poured-in-Place surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

PART 2 - PRODUCTS

2.1 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM

- A. Manufacturer: Surface America, Inc., PO Box 157, Williamsville, NY 14231, (716) 632-8413 Local contact: Recreation Resource Kevin Umbreit kevinu@recreation-resource.com or Safety Turf, Inc., 201 North 4th Avenue, P.O. Box 908, Royersford, PA 19468, (610) 792-0967, or approved equal.
- B. Product: Poured-in-place playground surfacing system as per Manufacturer - Surface America Proprietary Products/Systems, including the following:
 - 1. PlayBound Poured-In-Place Primer:
 - a. Material: Urethane.
 - 2. PlayBound Poured-in-Place Basemat:
 - a. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and urethane.
 - b. Thickness: To be coordinated and determined by fall height of play equipment.
 - c. Formulation Components: Blend of strand and granular material.
 - 3. PlayBound Poured-In-Place Top Surface:
 - a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) rubber and aliphatic urethane binder.
 - b. Thickness: 1/2" (12.7 mm) minimum, thicken to 3/4" under swings, ends of slides, play equipment entrances/exits, and areas where there will be increased foot traffic such as around spinning play equipment.
 - c. Color: 25% Black, 50% Purple, 25% Sky Blue
 - d. Dry Static Coefficient of Friction (ASTM D2047): 1.0.
 - e. Wet Static Coefficient of Friction (ASTM D2047): 0.9.
 - f. Dry Skid Resistance (ASTM E303): 89.
 - g. Wet Skid Resistance (ASTM E303): 57.
 - 4. Crushed Stone Base as per Manufacturer recommendations.

- a. The stone for the base must be compacted to a 95% Standard Proctor Compaction (as per A.S.T.M. Test). The stones shall be 2B (clean) stone that is spread and compacted to a flat surface leaving the thickness required safety surface below finish level.
- 5. Mixes
 - a. Required mix proportions by weight:
 - 1) Basemat: 16+% urethane (as ratio: 14% urethane divided by 86% rubber). 14% urethane, 86% rubber (based on entire rubber & urethane mix).
 - 2) Top Surface: 22% urethane (ratio: 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).

2.2 GEOSYNTHETICS

- A. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
 - 3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the playground surfacing manufacturer.

3.2 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, subgrade and substrate conditions, drainage, and other conditions affecting performance of the Work.
- B. Verify that play equipment is in place.
 - 1. Begin installation of safety surface immediately upon completion of play equipment installation.
- C. Verify that stone base is ready to receive poured-in-place safety surface.
 - 1. Verify gradients and elevations are correct.
- D. Beginning of installation means acceptance of existing conditions.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. General: Prepare substrates to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

3.4 INSTALLATION, GENERAL

- A. General: Comply with playground surface system manufacturer's written installation instructions. Install playground surface system over area and in thickness indicated.
- B. Secure manufacturer's representative to observe all phases of safety surface installation and provide Owner with a written statement certifying compliance with manufacturer's drawings and specifications.
- C. Install safety surface according to manufacturer's instructions and specifications in locations shown on Drawings.
 - 1. Meet or exceed current: CPSC guidelines, ADA guidelines and ASTM F-1292-93 requirements.

3.5 SUBGRADE

- 1. Compact soil subgrade in accordance with Philadelphia Water Department requirements.

3.6 GEOSYNTHETIC INSTALLATION

- A. General: Install geosynthetics according to playground surface system manufacturer's and geosynthetic manufacturer's written instructions.
 - 1. Geotextiles: Completely cover area indicated, overlapping sides and edges a minimum of 8 inches with manufacturer's standard treatment for overlapping loosely laid seams. Adhere edges on all sides to top of perimeter curb or footing.

3.7 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM INSTALLATION

- A. Crushed Stone Base Installation:
 - 1. The minimum depth of the stone base is 6". Thickness is never to exceed 10".
 - 2. The crushed stone base must be thoroughly compacted by using a tamper, roller or combination of both to a 95% compaction rate throughout the base.
- B. Basemat Installation:
 - 1. Using screeds and hand trowels, install the basemat at a consistent density of 29 pounds, 1 ounce per cubic foot (466 kg/m³) to the specified thickness indicated on drawings.
 - 2. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
 - 3. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured.
- C. Primer Application: Using a brush or short nap roller, apply primer to the basemat perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft²/gal (7.5 m²/L).

- D. Top Surface Installation:
1. Using a hand trowel, install top surface at a consistent density of 58 pounds, 9 ounces per cubic foot (938 kg/m³) to a nominal thickness of 1/2" (12.7 mm).
 2. Layout color areas to dimensions as shown on plan. There shall be no hard lines between colors. Blending zone is a mix of the two colors specified.
 3. Allow top surface to cure for a minimum of 48 hours.
 4. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
 5. Do not allow foot traffic or use of the surface until it is sufficiently cured.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of completed applications of playground surface system shall take place according to ASTM F 1292.
- C. Remove and replace applications of playground surface system where test results indicate that it does not comply with requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with requirements.

3.9 CLEAN UP

- A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

END OF SECTION 321816

SECTION 32 31 16
WELDED WIRE FENCE AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. SECTION INCLUDES:
 - 1. Welded wire fence panels and accessories.
 - 2. Cantilever gate.
- B. RELATED SECTIONS:
 - 1. Section 03 30 00: Cast-in-Place Concrete.

1.2 REFERENCES:

- A. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- B. ASTM A82 – Mechanical, Physical and Performance Properties of Carbon Steel Wire
- C. ASTM A641 – Zinc-Coated (Galvanized) Carbon Steel Wire
- D. ASTM A879 – Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
- E. ASTM B117 – Operating Salt Spray (Fog) Apparatus.
- F. RAL – German Institute for Quality Assurance and Indication.

1.3 SUBMITTALS

- A. Submittals shall be in accordance with Section 013300.
- B. Product Data: Submit manufacturer's product data, standard details, and installation instructions.
- C. Samples for color selection.
- D. Shop Drawings: Show locations of fence, gate, posts, rails, and details of gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage, attachment and bracing. Installation procedures and instructions by manufacturer describing all details for a typical fence and gates.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Fences and Gates: obtain each color, grade, finish, type, and variety of components for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from damage. Store panels flat. Provide edge protection when strapping is used. Do not apply loads to panel edges.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 MANUFACTURER

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide furnishings manufactured by Omega Fence Systems, (800) 836-6342, www.omegafence.com, or approved comparable product.

2.3 FENCE AND GATE: WELDED WIRE

- A. Welded Wire Fence with top and bottom tubing, galvanized steel
 1. Omega Secur Double Wire Fence
 - a. Height: 8'.
 - b. Color: Black
 - c. Post Bracket: Universal Collar Bracket
 - d. Tubing: Include top and bottom tubing
- B. Welded Wire Gates with top and bottom tubing, galvanized steel
 1. Omega Secur Double Wire swing gates
 - a. Height: 8'.
 - b. Width: As shown on drawings
 - c. Color: Black
 - d. Tubing: Include top and bottom tubing
 - e. Gate lock – Double Gate Catcher/Receiver as recommended by the Manufacturer.
 - f. Drop bar: secure both gates in closed position with stop pipe to engage the center drop rod.

2.4 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 1. Material above Finished Grade: Copper or Aluminum.
 2. Material on or below Finished Grade: Copper.
 3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Grounding Connectors and Grounding Rods: Comply with UL 467.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Field Measurements: verify layout information for fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Indicate locations of utilities, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening infill panels to posts.
- C. Post Excavation: Form or drill holes for sleeves as shown on drawings.
- D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Posts Set in Concrete: Extend post to within 6 inches (150 mm) of specified excavation depth, but not closer than 3 inches (75 mm) to bottom of concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non shrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post

3.3 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:
 - 1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m)

3.5 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 31 16

**SECTION 329100
PLANTING PREPARATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of Planting Soils. Scope of work includes, but is not limited to, sourcing, purchase, delivery and installation of Planting Soil and soil amendments and clean up and disposal of all excess and surplus material.
- B. The specific soil types in this section include:
 - 1. Planting Soil for plant beds and lawn

1.3 RELATED REQUIREMENTS

- A. Section 311000 Site Clearing
- B. Section 312000 Earthwork
- C. Section 329200 Lawn
- D. Section 329300 Plants

1.4 REFERENCE STANDARDS

- A. In the event that the requirements of any of the referenced standards and specifications herein conflict with each other the more stringent requirement shall prevail. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
- B. American Society for Testing Materials (ASTM):
 - 1. ASTM C33 – Gradation Requirements for Coarse Aggregates.
 - 2. ASTM C602 Standard Specification for Agricultural Liming Materials.
 - 3. ASTM D422 – Standard Test Method for Particle Size Analysis of Soils.
 - 4. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.

5. ASTM D3385 – Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.
6. ASTM D4972 – Standard Test Method for pH of Soils.
7. ASTM D5298 – Standard Specification for Topsoil Used for Landscaping Purposes.
8. ASTM D7481 – Standard Test Methods for Determining Loose and Tapped Bulk Densities of Powders using a Graduated Cylinder.
9. ASTM F1632 – Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes.
10. ASTM F1647 – Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes.
11. ASTM F1815 – Standard Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones.

C. Other Standards:

1. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service, Soil Texture Calculator.
2. USDA, Natural Resources Conservation Service, 2003. National Soil Survey Handbook, title 430-VI, current edition.
3. USDA Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report, current edition.
4. Environmental Protection Agency (EPA) Section 503 Regulations.
5. Department of Environmental Protection (DEP), Pennsylvania Bulletin, Management of Fill, Clean Fill Policy, current edition.
6. U.S. Composting Council (USCC), Test Methods for the Examination of Composting and Compost (TMECC), current edition.
7. USCC, Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost.
8. Association of Official Analytical Chemists (AOAC), Official Methods of Analysis, current edition.
9. Soil Science Society of America (SSSA), Methods of Soil Analysis, current edition.

1.5 DEFINITIONS

- A. Bulk Density: is an indicator of soil compaction calculated as the dry weight of soil by its volume typically expressed in g/cm³.
- B. Coarse Sand: sharp natural or manufactured fine aggregate and further defined in this specification.
- C. Compacted soil: soil where the density of the soil is greater than the threshold for root limiting, and further defined in this specification.
- D. Compost: Well decomposed stable organic material as defined by the US Composting Council and further defined in this specification.

- E. Planting Soil: Planting soil shall be harvested from fields or development sites or manufactured uniformly mixed individual soil components (Topsoil, Sand, Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.
- F. Topsoil: Naturally produced and harvested soil from the A horizon or upper layers or the soil as further defined in this specification.
- G. Salvaged Topsoil: Topsoil stripped from the Project Site and prepared for reuse at the Project Site.

1.6 SUBMITTALS

- A. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- B. Submit dated certificates or letters, signed by the materials producer, stating that materials meet or exceed the specified requirements.
- C. For each type of manufactured product, submit data and certificates that the product meets the specification requirements, signed by the product manufacturer, and complying with testing requirements and referenced standards and specific requested testing.
- D. Laboratory soil testing requirements:
 - 1. Samples of soil(s) to be submitted to an approved soil testing laboratory for testing in accordance with specifications herein. Submit the soil testing laboratory for review and approval prior to commencing with any soil testing.
 - 2. Test results shall be submitted to the Landscape Architect for approval in conjunction with soil amendment products in accordance with soil testing laboratory recommendations.
 - 3. Submit soil test reports including test results for each criteria listed within the Products section herein for:
 - a. Individual Components for Soil Mixes: Topsoil, Compost and Sand.
 - b. Soil Mixes Using Individual Components.
 - c. Test reports for Individual Components and Soil Mixes must be submitted concurrently.
 - d. The source of supply for Individual Components for Soil Mixes and Soil Mixes Using Individual Components must be indicated on the test report submittals.
 - 4. Test reports must be the same material to be supplied and must be current within the period of time defined as follows unless approved otherwise by the Landscape Architect:
 - a. Topsoil: no more than 6 months old.
 - b. Salvaged Topsoil: no more than 6 months old.
 - c. Compost: no more than 3 months old.
 - d. Sand: no more than 6 months old.
 - e. Planting Soil: test data must be no more than 1 month old.
 - f. Sample test results shall be considered valid until the time of construction and for the material supplied.

5. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Landscape Architect.
6. Soils shall not contain any traces of hydrocarbons, petroleum products, chemically prohibited substances, or any other elements considered to be toxic to any vegetation that is used. Clean fill certification shall be submitted by the manufacturer.
7. All soil testing will be at the expense of the Contractor.

E. Physical samples:

1. All samples must be submitted simultaneously with the laboratory test reports. Samples are required for the following:
 - a. Salvaged Topsoil
 - b. Manufactured Planting Soil
2. Provide one (1) one-gallon sample in a resealable plastic bag to the Landscape Architect.

1.7 ON-SITE VERIFICATION SOIL TESTING REQUIREMENTS

A. Landscape Architect may require Compaction Testing:

1. Maintain an up-to-date written report of compaction test results. Test compaction every 12-inch lift of soil for every 300 square feet of soil installed for each planting area designated on the Drawings. The Landscape Architect may review the written report at any time to confirm conformance with the specification. Submit final report at the completion of soil installation.
2. Maintain at the site at all times a soil cone penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
 - a. Penetrometer shall be AgraTronix Soil Compaction Meter or approved equal.
 - b. Moisture meter shall be "general digital soil moisture meter".

B. Should any verification test results indicate soil material is not consistent with the approved submittals or requirements specified herein, the Contractor shall remove the installed soil and re-install soil at the Contractors expense until the Contract Document requirements are met.

C. Accompany each delivery of soil mixes, bulk materials, fertilizers and soil amendments provide the appropriate certificates and delivery tickets to the Landscape Architect. The soil supplier must be indicated on delivery tickets for all soil mix deliveries and the supplier must match the approved submittals.

1.8 QUALITY ASSURANCE

A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, PADEP Clean Fill Guidance, unless otherwise specified.

B. Soil Testing Laboratory Qualifications: The laboratory shall be an independent laboratory, recognized by the State Department of Agriculture. The testing laboratory must have experience in performing agronomic testing including physical and chemical properties of soil. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists and follow standards from the NRCS Soils Manual and ASTM testing methods applicable to the specific tests requested. Laboratory shall have staff fully qualified to review

test results, and to make recommendations to amend samples based on what is planned to grow in the soil. American Association for Laboratory Accreditation (A2LA) certification is preferred.

1. Compost that participates in the US Composting Council's Seal of Testing Assurance (STA) Program and tested through an STA program lab, using appropriate test methods from the TMECC (Test Methods for the Examination of Compost and Composting) is preferred. Test data shall be presented on a Compost Technical Data Sheet.

- C. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the Landscape Architect and the University.
- D. Installer Qualifications: The installer shall be a firm having at least five (5) years of experience of a scope similar to that required for the work.
 1. Installer Field Supervision: When any soil work is in progress, installer shall maintain, on-site, an experienced full-time supervisor.
 2. Installer's field supervisor shall have a minimum of five (5) years experience as a field supervisor installing soil, shall be trained and proficient in the use of field surveying equipment to establish grades.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Preparation, amendment, and mixing of soils shall be performed at the soil supplier location.
- B. Weather: Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity. Soils shall not be handled, hauled, placed, or compacted when wet or frozen. Soil shall only be handled when the moisture content is between the specified ranges in percent water by volume.
- C. Protect soil and soil stockpiles, including the stockpiles at the soil blender's yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Once spread, soils shall be protected with staked erosion control blankets.
- D. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological additives shall be protected from extreme cold and heat. All products shall be freshly manufactured and dated for the year in which the products are to be used.
- E. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
- F. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- G. None of the soil materials shall be delivered to the site until sample certifications are approved by the Landscape Architect, however, such approval does not constitute final acceptance.

Certification submittal shall include recommended soil amendment products if proposed to modify the soils. Any approval of soils made conditional upon utilizing one or more amendments shall be understood to afford to the Landscape Architect the right for further testing and refusal of materials that do not meet these Specifications.

PART 2 - PRODUCTS

2.1 Individual Components for Soil Mixes

A. Topsoil

1. Topsoil definition: Topsoil shall be a harvested from the Project Site or fields or development sites and shall be loose, friable mineral particles resulting from natural soil formation from the A, E and upper B horizons, or "solum" where most plant roots grow. Manufactured soils where sand, composted organic material, chemical additives or similar elements has been blended to meet the requirements of Topsoil is not acceptable. The soil shall be free of construction and trash debris, rocks, hydrocarbons, petroleum materials, herbicides, or other harmful contaminants that would impact plant growth.
 - a. Topsoil shall comply with the following parameters:
 - i) Organic matter (ASTM F1647, Method A): 1.5% minimum (by dry weight).
 - ii) pH (1 soil : 1 water): 5.0 - 7.0.
 - b. Stockpiled Existing Topsoil at the site meeting the above criteria may be acceptable.

B. Organic Amendment / Compost

1. Compost is as defined by the "US Composting Council Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost". Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; leaf litter and yard trimmings; or source-separated waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.
2. Compost shall comply with the following parameters:
 - a. pH: 6.0 - 8.0.
 - b. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 5 dS/m (mmhos/cm).
 - c. Compost derived from stabilized mushroom soil compost may possess a maximum EC of 10 dS/m (1:2), if the maturity testing is a minimum of 95% and ammonia (NH4) content is a maximum of 250 ppm.
 - d. Moisture content %, wet weight basis: 30 – 60.
 - e. Organic Matter Content, % dry weight basis: 30 – 65.
 - f. Particle size, dry weight basis: 98% pass through 1/2 inch screen.
 - g. Stability carbon dioxide evolution rate: mg CO₂-C/ g OM/ day ≤ 3.
 - h. Maturity, seed emergence and seedling vigor, % relative to positive control: minimum 80%.

- i. Physical contaminants (inerts), %, dry weight basis: <0.5%.
- j. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40CFR § 503.13, Tables 3 levels.
- k. Biological contaminants select pathogens fecal coliform bacteria, or salmonella, meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) level requirements.

C. Coarse Sand

1. Sharp natural or manufactured fine aggregate shall be hard and durable and free of limestone (calcareous sand), shale and slate particles and free of harmful contaminants that would impact plant growth complying with the following parameters:

- a. pH shall be lower than 7.0.
- b. Sieve analysis:

<u>Sieve</u>	<u>Percent passing (by mass)</u>
3/8 inch (9.5 mm)	100
No 4 (4.75 mm)	95-100
No 8 (2.36 mm)	80-100
No 16 (1.18 mm)	50-85
No 30 (.60 mm)	25-75
No 50 (.30 mm)	5-40
No 100 (.15 mm)	2-20
No 200 (0.75 mm)	2-15

- c. Particle analysis must be per USDA classification, Sand.
 - Sand (2 - 0.05 mm): ≥88%
 - Silt (0.05 - 0.002 mm): ≤9%
 - Clay (< 0.002 mm): ≤3%

D. Chemical Amendments

1. Lime, ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
 - a. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
 - b. Provide lime in form of dolomitic limestone.

2.2 Soil Mixes Using Individual Components

A. Definition

1. Manufactured uniformly mixed individual soil components (Salvaged Topsoil, Topsoil, Sand, Compost) meeting the criteria specified herein. Provide Soils at the locations indicated on the Drawings complying with the following parameters.

B. Planting Soil, Plant Beds and Lawn

1. Planting soil shall be manufactured from uniformly mixed individual soil components (Salvaged Topsoil, Sand, Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.
2. Provide Planting Soil at the locations indicated on the Drawings complying with the following parameters:

- a. Particle analysis must be per USDA classification for loam, sandy loam, sandy clay loam, or silt loam within the following parameters using ASTM D422:
 Sand: 45 - 55%
 Silt: no more than 30%
 Clay: no more than 20%
 Gravel content larger than 2mm shall be less than 12%.
- b. pH (1 soil : 1 water): 6.0 - 7.2.
- c. Organic matter (ASTM F1647, Method A): 3 - 6% (by dry weight).
- d. Hydraulic conductivity (ASTM F1815) at 85% Proctor (ASTM D698): 1.0 in/hr +/- 0.5 in/hr
- e. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 1.60 mmho/cm. Sodium (Na) salinity shall not exceed 700 ppm.
- f. Cation Exchange Capacity (CEC): >15 meq/100g.
- g. Nutrient analysis including macronutrients and micronutrients (Mehlich-3) with soil fertility interpretation and recommendations relevant to the specified plant species.
- h. Compost shall not be added at more than 30% by volume.

C. Erosion Control Mat

- 1. Straw Blanket
 - a. For use on 4:1 to 3:1 slopes with moderate runoff conditions: utilize ECS-1 Single Net Straw Rolled Erosion Control Blanket, East Coast Erosion Blankets, 443 Bricker Road, Bernville, PA 19506, 800-582-4005, www.erosionblankets.com, or approved equal.
 - b. Matting containing non-degradable plastic mesh is prohibited.
- 2. Straw Mulch:
 - a. For use on slopes less than or equal 4:1 with minimal runoff conditions: utilize mildew-free and seed-free salt hay with a nonasphaltic liquid tackifier.

D. Amendments

- 1. At the time of final grading, add fertilizer if required to the Planting Soil at rates recommended by the testing results for the species of plants to be grown.

PART 3 - EXECUTION

3.1 SITE EXAMINATION

- A. Prior to installation of soil, examine site to confirm that existing conditions are satisfactory for the work of this section to proceed. The Landscape Architect shall approve the condition of the subgrade and the previously installed subgrade preparation and the installation of subsurface drainage.
 - 1. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope toward the under drain lines as shown on the Drawings.
 - a. Subgrade definition: surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing Planting Soil.
 - 2. Confirm that all surface areas to be filled with Soil are free of construction debris, refuse, compressible or biodegradable materials, stones greater than 2 inches diameter, soil

crusting films of silt or clay that reduces or stops drainage from the Soil into the subsoil; and/or standing water. Remove unsuitable material from the site.

- a. Debris definition: Elements including, but not limited to, concrete, concrete masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.
 3. Confirm that no adverse drainage conditions are present.
 4. Confirm that no conditions are present which are detrimental to plant growth.
- B. If unsatisfactory conditions are encountered, notify the Landscape Architect immediately to determine corrective action before proceeding.

3.2 SOIL INSTALLATION

- A. All equipment utilized to install or grade Soils shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6 inch long teeth to scarify any soil that becomes compacted.
- B. In areas of soil installation above existing subsoil, scarify the subgrade material prior to installing Soil.
1. Scarify the subsoil of the subgrade to a depth of 3 – 6 inches with the teeth of the back hoe or loader bucket, tiller or other suitable device.
 2. Immediately install the Planting Soil. Protect the loosened area from traffic. DO NOT allow the loosened subgrade to become compacted.
 3. In the event that the loosened area becomes overly compacted, loosen the area again prior to installing the Planting Soil.
- C. Install the Planting Soil in 6 inch lifts to the required depths. Minimum depth of planting soil in plant beds is 24 inches or as shown on the Drawings.
1. Apply compacting forces to each lift as required to attain the required compaction. Scarify the top of each lift prior to adding more Planting Soil by dragging the teeth of a loader bucket or backhoe across the soil surface to roughen the surface.
 2. Approved compaction equipment includes a smooth drum roller or plate compactor. Typically one to three passes per lift will achieve the desired compaction. Contractor to test desired compaction methodology with actual soil to be installed to confirm installation method and material properties are compatible and will achieve the specified compaction rates.
 3. Provide adequate equipment to achieve consistent and uniform compaction of the Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction. Use the same equipment and methods of compaction for the entire project area once soil, installation methodology, and compaction criteria have been coordinated and confirmed.
- D. Do not pass motorized equipment over previously installed and compacted soil except as authorized below.
1. Light weight equipment such as trenching machines or motorized wheel barrows is permitted to pass over finished soil work.

2. If work after the installation and compaction of soil compacts the soil to levels greater than the above requirements, follow the requirements of Over Compaction Reduction herein.
- E. Phase work such that equipment to deliver or grade soil does not have to operate over previously installed Planting Soil. Work in rows of lifts the width of the extension of the bucket on the loader. Install all lifts in one row before proceeding to the next. Work out from the furthest part of each bed from the soil delivery point to the edge of each bed area.
 - F. Where travel over installed soil is unavoidable, limit paths of traffic to reduce the impact of compaction in Planting Soil. Each time equipment passes over the installed soil it shall reverse out of the area along the same path with the teeth of the bucket dropped to scarify the soil. Comply with Over Compaction Reduction herein in the event that soil becomes over compacted. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by the Landscape Architect.
 - G. The depths and grades shown on the Drawings are the final grades after settlement and shrinkage of the compost material. The Contractor shall install the Planting Soil at a higher level to anticipate this reduction of Soil volume. A minimum settlement of approximately 10 - 15% of the soil depth is expected. All grade increases are assumed to be as measured prior to addition of surface Compost till layer, or mulch.
 - H. Maintain moisture conditions within the Soil during installation or modification to allow for satisfactory compaction.
 1. Volumetric soil moisture level during installation shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil texture	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%
 2. The Contractor shall confirm the soil moisture levels with a moisture meter (Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent). Suspend operations if the Soil becomes wet. Apply water if the soil is overly dry.
 - I. Installing Planting Soil with soil or mulch blowers or soil slingers is not permitted.

3.3 SOIL COMPACTION REQUIREMENTS FOR PLANT BEDS AND LAWN

- A. The following are threshold levels of compaction as determined by each method for the subsoil surface and full profile of Planting Soil, testing each lift of Soil with a penetrometer. The same penetrometer and moisture meter shall be used to test installed soil throughout the work.

1. Acceptable Compaction
 - a. Standard Proctor Method – 75-85%.
 - b. Penetration Resistance Method – about 75-250 psi.
 - c. Soil below 75 psi soil becomes increasingly unstable and will settle excessively.
2. Unacceptable Compaction
 - a. Standard Proctor Method – Above 85%.
 - b. Penetration Resistance Method – Approximately above 300 psi
3. Prior to testing the soil with the penetrometer check the soil moisture. Penetrometer readings are impacted by soil moisture and excessively wet or dry soils will read significantly lower or higher than soils at optimum moisture.
4. The penetrometer readings shall be within 20% plus or minus of the specified levels.
5. Where the Standard Proctor Method is utilized, the following Bulk Density levels based on 75% minimum and 85% maximum standard Proctor indicate acceptable compaction.

Soil Texture	Bulk Density (g/cm ³)	
	Max.	Min.
Loamy Sand	1.80	1.65
Sandy Loam	1.65	1.45
Sandy Clay Loam	1.55	1.35
Loam	1.50	1.30
Silt Loam	1.45	1.25

3.4 OVER COMPACTION REDUCTION

- A. Compacted soil: soil where the density of the soil, at each lift for the full profile, is greater than the threshold for root limiting, and further defined in this specification.
- B. Any soil that becomes compacted to a density greater than the specified density shall be dug up and reinstalled. This requirement includes compaction caused by other sub-contractors after the Planting Soil is installed and approved.
- C. Surface roto tilling shall not be considered adequate to reduce over compaction at levels 6 inches or greater below finished grade.

3.5 INSTALLATION OF CHEMICAL ADDITIVES

- A. Following the installation of each soil and prior to fine grading and installation of the Compost till layer, apply chemical additives as recommended by the soil test, and appropriate to the soil and specific plants to be installed.
- B. Types, application rates and methods of application shall be approved by the Landscape Architect prior to any applications.

3.6 FINE GRADING

- A. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes other suitable devices, and further defined in this specification, and further defined in this specification.
- B. The Landscape Architect shall approve all rough grading prior to the installation of Compost, fine grading
- C. Grade the finish surface of all planted areas to meet the grades shown on the Drawings, allowing the finished grades to remain higher than the grades on the grading plan, as defined in paragraph Soil Installation, to anticipate settlement over the first year.
- D. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.
- E. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the Landscape Architect in the event that conditions make it impossible to achieve positive drainage.
- F. Provide smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is one or two inches below all paving surfaces or as directed by the Drawings.

3.7 INSTALLATION OF IN-SITU COMPOST AMENDMENT

- A. After Planting Soil is installed in planting bed areas, spread 2 – 3 inches of Compost over the beds and roto till into the top 4 - 6 inches of the Planting Soil. This step will raise grades slightly above the grades required in Fine Grading herein. This specification anticipates that the raise in grade due to this tilling will settle within a few months after installation as Compost breaks down. Additional settlement as defined in paragraph "Soil Installation" must still be accounted for in the setting of final grades.
- B. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, (or spade tiller), and further defined in this specification.

3.8 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.

3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

- B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by the Landscape Architect and replace contaminated planting soil with new planting soil.

3.9 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329100

SECTION 329110 – GREEN STORMWATER INFRASTRUCTURE SOILS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of Stormwater Soils related to green stormwater infrastructure and associated planting. Scope of work includes, but is not limited to, sourcing, purchase, delivery and installation of Stormwater Soil and soil amendments, clean up and disposal of all excess and surplus material, and placement of erosion control matting over all soil surfaces not stabilized through planting.
- B. The specific soil types in this section include:
 - 1. Stormwater Soil – Standard Blend

1.2 REFERENCE STANDARDS

- A. In the event that the requirements of any of the referenced standards and specifications herein conflict with each other the more stringent requirement shall prevail. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
- B. American Society for Testing Materials (ASTM):
 - 1. ASTM C33 – Gradation Requirements for Coarse Aggregates.
 - 2. ASTM C602 – Standard Specification for Agricultural Liming Materials.
 - 3. ASTM D422 – Standard Test Method for Particle Size Analysis of Soils.
 - 4. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 5. ASTM D3385 – Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.
 - 6. ASTM D4972 – Standard Test Method for pH of Soils.
 - 7. ASTM D5298 – Standard Specification for Topsoil Used for Landscaping Purposes.
 - 8. ASTM D7481 – Standard Test Methods for Determining Loose and Tapped Bulk Densities of Powders using a Graduated Cylinder.
 - 9. ASTM F1632 – Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes.
 - 10. ASTM F1647 – Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes.
 - 11. ASTM F1815 – Standard Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones.
- C. Other Standards:
 - 1. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service, Soil Texture Calculator.
 - 2. USDA, Natural Resources Conservation Service, 2003. National Soil Survey Handbook, title 430-VI, current edition.
 - 3. USDA Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report, current edition.
 - 4. Environmental Protection Agency (EPA) Section 503 Regulations.
 - 5. Department of Environmental Protection (DEP), Pennsylvania Bulletin, Management of Fill, Clean Fill Policy, current edition.

6. U.S. Composting Council (USCC), Test Methods for the Examination of Composting and Compost (TMECC), current edition.
7. USCC, Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost.
8. Association of Official Analytical Chemists (AOAC), Official Methods of Analysis, current edition.
9. Soil Science Society of America (SSSA), Methods of Soil Analysis, current edition.
10. Modified Philip Dunne (MPD) Infiltrometer method for measurement of the saturated hydraulic conductivity of surface soil.
11. Philadelphia Parks and Recreation Contractor Guidelines.

1.3 DEFINITIONS

- A. Amendment: product added to topsoil to improve soil's physical qualities. Amendments are classified as general soil amendments, fertilizers, biological, and pH amendments.
- B. Bulk Density: an indicator of soil compaction calculated as the dry weight of soil by its volume typically expressed in g/cm³.
- C. Coarse Sand: sharp natural or manufactured fine aggregate and further defined in this specification.
- D. Compacted soil: soil where the density of the soil is greater than the threshold for root limiting, and further defined in this specification.
- E. Compost: Well-decomposed stable organic material as defined by the US Composting Council and further defined in this specification.
- F. Debris: Elements including, but not limited to, concrete, concrete masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.
- G. Drainage: The process of water moving through the soil, transitioning the soil from dry to saturated to field capacity, the rate of which may be expressed as the saturated hydraulic conductivity rate (Ksat; units are inches per hour).
- H. Existing Soil: Mineral soil existing at the locations of proposed planting after the majority of the construction within and around the planting site is completed and just prior to the start of work to prepare the planting area for soil modification and/or planting, and further defined in this specification.
- I. Fertilizer: amendment used for the purpose of adjusting soil nutrient composition and balance.
- J. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes other suitable devices, and further defined in this specification.
- K. Finished grade: surface or elevation of Soil after final grading and 12 months of settlement of the soil, and further defined in this specification.
- L. Planting Soil: Planting soil shall be harvested from fields or development sites or manufactured uniformly mixed individual soil components (Topsoil, Sand, and Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.

- M. Salvaged Topsoil: Stripped native loam removed within the limits of work, but outside of the "Tree Protection Areas", to its entire natural depth.
- N. Scarify: Loosening and roughening the surface of soil and sub soil prior to adding additional soil on top, and further defined in this specification.
- O. Soil Horizons: as defined in the USDA National Soil Survey Handbook (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)
- P. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, (or spade tiller), and further defined in this specification.
- Q. Stormwater Soil: Manufactured uniformly mixed individual soil components (Topsoil, Sand, Compost) meeting the criteria specified herein intended to provide water quality management by filtering stormwater runoff and provide sufficient infiltration for management of specified quantities of surface water flows.
- R. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill immediately beneath Planting Soil or Stormwater Soil.
- S. Topsoil: Topsoil shall be a harvested from fields or development sites and shall be loose, friable mineral particles resulting from natural soil formation from the A, E and upper B horizons, or "solum" where most plant roots grow and as defined further herein.

1.4 SUBMITTALS

- A. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- B. Submit dated certificates or letters, signed by the materials producer, stating that materials meet or exceed the specified requirements.
- C. Submit samples of soil(s) to an approved soil testing laboratory for testing. Send samples no less than one (1) month and no greater than three (3) months before delivery to the worksite. Submit soil test reports with results to Owner/Authorized Representative for each criterion listed within the Part 2 Products section herein for Individual Components for Soil Mixes (Topsoil, Compost and Sand) and for Soil Mixes Using Individual Components (Stormwater Soils).
 - 1. Test reports for Individual Components and Soil Mixes must be submitted concurrently.
 - 2. The source of supply for Individual Components for Soil Mixes and Soil Mixes Using Individual Components must be indicated on the test report submittals.
 - 3. Test reports must be the same material to be supplied and must be current within the period of time defined as follows unless approved otherwise by Owner/Authorized Representative. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by Owner/Authorized Representative. No soils shall be delivered to the worksite until approved by Owner/Authorized Representative.
 - a. Topsoil: no more than six (6) months old.
 - b. Compost: no more than three (3) months old.
 - c. Sand: no more than six (6) months old.
 - d. Planting Soil and Stormwater Soil: test data must be no more than three (3) months old.
 - 4. Sample test results shall be considered valid until the time of construction and for the material supplied.

- D. Provide one (1) one-gallon sample in a resealable plastic bag to Owner/Authorized Representative prior to delivery to site. All samples must be submitted simultaneously with the laboratory test reports described in 1.4C. Samples are required for the following:
 - 1. Stormwater Soil blends.
 - 2. In-situ Soil Amendments: Compost.
- E. Submit appropriate certificates and delivery tickets to Owner/Authorized Representative for each delivery of soil mixes, bulk materials, fertilizers and soil amendments. The soil supplier must be indicated on delivery tickets for all soil mix deliveries and the supplier must match the approved submittals.
- F. Submit final soil moisture and compaction testing reports at the completion of soil installation per Part 3.3 and 3.4 of the specifications herein.

1.5 LABORATORY SOIL TESTING REQUIREMENTS

- A. The laboratory shall be an independent laboratory, recognized by the State Department of Agriculture. The testing laboratory must have experience in performing agronomic testing including physical and chemical properties of soil. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists and follow standards from the NRCS Soils Manual and ASTM testing methods applicable to the specific tests requested. Laboratory shall have staff fully qualified to review test results, and to make recommendations to amend samples based on what is planned to grow in the soil. American Association for Laboratory Accreditation (A2LA) certification is preferred.
- B. Compost that participates in the US Composting Council's Seal of Testing Assurance (STA) Program and tested through an STA program lab, using appropriate test methods from the TMECC (Test Methods for the Examination of Compost and Composting) is preferred. Test data shall be presented on a Compost Technical Data Sheet.
- C. All soil testing will be at the expense of the Contractor.

1.6 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, PADEP Clean Fill Guidance, PADEP state health standards for residential areas, unless otherwise specified. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the Owner/Authorized Representative.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Preparation, amendment, and mixing of soils shall be performed at the soil supplier location.
- B. Weather: Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity. Soils shall not be handled, hauled, placed, or compacted when wet or frozen. Soil shall only be handled when the moisture content is between the specified ranges in percent water by volume as defined in Part 3.03 of the specifications herein.
- C. Protect soil and soil stockpiles, including the stockpiles at the soil blender's yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by

chemicals, dust and debris that may be detrimental to plants or soil drainage. Once spread, soils shall be protected with staked erosion control blankets.

- D. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological additives shall be protected from extreme cold and heat. All products shall be freshly manufactured and dated for the year in which the products are to be used.
- E. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
- F. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- G. None of the soil materials shall be delivered to the site until sample certifications are approved by Owner/Authorized Representative, however, such approval does not constitute final acceptance. Certification submittal shall include recommended soil amendment products if proposed to modify the soils. Any approval of soils made conditional upon utilizing one or more amendments shall be understood to afford to the Owner/Authorized Representative the right for further testing and refusal of materials that do not meet these Specifications.
- H. Soils shall not be stored on-site for longer than one (1) month prior to installation.

PART 2 - PRODUCTS

2.1 INDIVIDUAL COMPONENTS FOR SOIL MIXES

- A. Soils shall not contain any traces of hydrocarbons, petroleum products, chemically prohibited substances, or any other elements considered to be toxic to human health and any of the vegetation that is used.
- B. TOPSOIL
 1. Topsoil definition: Topsoil shall be a harvested from fields or development sites and shall be loose, friable mineral particles resulting from natural soil formation from the A, E and upper B horizons, or "solum" where most plant roots grow. Manufactured soils where sand, composted organic material, chemical additives or similar elements has been blended to meet the requirements of Topsoil is not acceptable. The soil shall be free of construction and trash debris, rocks, hydrocarbons, petroleum materials, herbicides, or other harmful contaminants that would impact plant growth.
 2. Topsoil shall comply with the following parameters:
 - a. Organic matter (ASTM F1647, Method A): 1.5% minimum (by dry weight).
 - b. pH (1 soil : 1 water): 5.0 - 7.0.
 3. Stockpiled Existing Topsoil at the site meeting the above criteria may be acceptable.
- C. ORGANIC AMENDMENT / COMPOST
 1. Compost is as defined by the "US Composting Council Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost". Compost shall be a well decomposed, stable, weed-free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; leaf litter and yard trimmings; or source-separated waste. The product shall contain no substances toxic to plants and shall be

reasonably free (< 1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.

2. Compost shall comply with the following parameters:
 - a. pH: 6.0 - 8.0.
 - b. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 5 dS/m (mmhos/cm).
 - 1) Compost derived from stabilized mushroom soil compost may possess a maximum EC of 10 dS/m (1:2), if the maturity testing is a minimum of 95% and ammonia (NH₄) content is a maximum of 250 ppm.
 - c. Moisture content %, wet weight basis: 30 – 60.
 - d. Organic Matter Content, % dry weight basis: 30 – 65.
 - e. Particle size, dry weight basis: 98% pass through 1/2 inch screen.
 - f. Stability carbon dioxide evolution rate: mg CO₂-C/ g OM/ day ≤ 3.
 - g. Maturity, seed emergence and seedling vigor, % relative to positive control: minimum 80%.
 - h. Physical contaminants (inerts), %, dry weight basis: <0.5%.
 - i. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40CFR § 503.13, Tables 3 levels.
 - j. Biological contaminants select pathogens fecal coliform bacteria, or salmonella, meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) level requirements.

D. COARSE SAND

1. Sharp natural or manufactured fine aggregate shall be hard and durable and free of limestone (calcareous sand), shale and slate particles and free of harmful contaminants that would impact plant growth complying with the following parameters:
 - a. pH shall be lower than 7.0.
 - b. Sieve analysis:

Sieve	Percent passing (by mass)
3/8 inch (9.5 mm)	100
No 4 (4.75 mm)	95-100
No 8 (2.36 mm)	80-100
No 16 (1.18 mm)	50-85
No 30 (.60 mm)	25-75
No 50 (.30 mm)	5-40
No 100 (.15 mm)	2-20
No 200 (0.075 mm)	2-15
 - c. Particle analysis must be per USDA classification, Sand.

Particle Size	Percent passing (by mass)
Sand (2 – 0.05 mm)	≥88%
Silt (0.05 – 0.002 mm)	≤9%
Clay (< 0.02 mm)	≤3%

E. CHEMICAL AMENDMENTS

1. Lime, ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
 - a. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.

- b. Provide lime in form of dolomitic limestone.

2.2 SOIL MIXES USING INDIVIDUAL COMPONENTS

A. DEFINITION

1. Manufactured uniformly mixed individual soil components (Topsoil, Sand, Compost) meeting the criteria specified herein. Provide Stormwater Soils at the locations indicated on the Drawings complying with the following parameters.

B. STORMWATER SOIL – STANDARD BLEND

1. Stormwater soil shall be a fertile, natural soil, free from large stones, roots, sticks, clods, plants, peat, sod, pockets of coarse sand, pavement and building debris, glass, noxious weeds (including invasive species), infestations of undesirable organisms and disease-causing pathogens, and other extraneous materials harmful to growth.
2. The texture of the stormwater soil should conform to the classification within the United States Department triangle for Sandy Loam or Loamy Sand. Stormwater soil should be a mixture of sand, silt and clay particles as required to meet the classification. Ranges of particle size distribution as determined by pipette method in compliance with ASTM F-1632, are as follows
 - a. Sand (0.05 to 2.0 mm): 50-85%
 - b. Silt (0.002 to 0.05 mm): 40% maximum
 - c. Clay (less than 0.002 mm): 10% maximum
 - d. Gravel (2.0 to 12.7 mm): 15% maximum
3. Stormwater soil should be screened and free of stones larger than a half-inch (12.7 millimeters) in any dimension. No more than 10% of the soil volume should be composed of soil peds greater than one inch.
4. Clods, or natural clumps of soil, greater than three inches in any dimension should be absent from the stormwater soil. Small clods ranging from one to three inches and peds, natural soil clumps under one inch in any dimension, may be present but should not make up more than 10% of the soil by volume.
5. The pH of the soil should have a range of 5.8 to 7.1.
6. Organic content of the soil should have a range of 3% to 15% by weight, as determined by loss on ignition (ASTM D2974). To adjust organic content, planting soil may be amended, prior to placing and final grading, with the addition of organic compost.
7. Hydraulic conductivity (ASTM F1815) at 85% Proctor (ASTM D698): 2.0 - 4.0 in/hr.
8. Soluble salts should be less than 2.0 mmhos/cm (dS/m), typically measured by 1:2 soil-water ratios basic soil salinity testing. Sodic soils are not acceptable for use regardless of amendment.
9. Cation Exchange Capacity (CEC): not less than 12 meq/100g.
10. Nutrient analysis including macronutrients and micronutrients (Mehlich-3) with soil fertility interpretation and recommendations relevant to the specified plant species.
11. Compost shall not be added at more than 30% by volume.

C. AMENDMENTS

1. At the time of final grading, add fertilizer if required to the Stormwater Soil and Planting Soil at rates recommended by the testing results for the species of plants to be grown.

D. SUPPLIERS

1. Soils commonly utilized for Owners work have been confirmed to be available from the list of suppliers shown below. This list does not constitute acceptance or endorsement of soil from these suppliers, nor is the Contractor bound to purchase landscaping materials from suppliers on this list.
 - a. American Biosoils & Compost, Douglassville PA, 610-222-3580
 - b. County Conservation Company, Sewell NJ, 856-227-6900

- c. GreenPRO Materials, Jackson, NJ, 908-647-0159
- d. Laurel Valley Soils, Landenberg, PA, 866-587-6457
- e. Ridgewood Soils, Birdsboro, PA, 610-816-0364

PART 3 - EXECUTION

3.1 SITE EXAMINATION

- A. Prior to installation of Soil, examine site to confirm that existing conditions are satisfactory for the work of this section to proceed. The Owner/Authorized Representative shall approve the condition of the subgrade and the previously installed subgrade preparation and the installation of subsurface drainage.
 - 1. Confirm that the subgrade is at the proper elevation and compacted as required.
 - 2. Confirm that all surface areas to be filled with Soil are free of construction debris, refuse, compressible or biodegradable materials, stones greater than 2 inches diameter, soil crusting films of silt or clay that reduces or stops drainage from the Soil into the subsoil; and/or standing water. Remove unsuitable material from the site.
 - 3. Confirm that no adverse drainage conditions are present.
- B. If unsatisfactory conditions are encountered, notify the Owner/Authorized Representative immediately to determine corrective action before proceeding.

3.2 PROTECTION

- A. Identify protection zones according to Section 015639 "Construction Tree Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the soil and contamination; restore the subgrade as directed by Owner/Authorized Representative and replace contaminated soil with new soil.

3.3 CONSTRUCTION CERTIFICATION FORM

- A. The contractor shall fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor shall make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
 - 1. Professional Engineer

2. Registered Architect
 3. Landscape Architect
 4. Professional Land Surveyor
 5. Professional Geologist
 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
1. Geotextile
 2. Stone
 3. Storage media
 4. Piping
 5. Soil
 6. Other SMP-related devices or appurtenances.

3.4 SOIL INSTALLATION

- A. The Philadelphia Water Bureau of Laboratory Services (BLS) sample and testing report from soil delivered to worksite must be approved by Owner/Authorized Representative prior to soil installation as defined in 1.06 Submittals of the specifications herein.
- B. All equipment utilized to install or grade Soils shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6 inch long teeth to scarify any soil that becomes compacted.
- C. In areas of soil installation above existing subsoil, scarify the subgrade material prior to installing Soil.
1. Scarify the subsoil of the subgrade to a depth of 3 – 6 inches with the teeth of the back hoe or loader bucket, tiller or other suitable device.
 2. Protect the loosened area from traffic. DO NOT allow the loosened subgrade to become compacted.
 3. In the event that the loosened area becomes overly compacted, loosen the area again prior to installing the Stormwater Soil or Planting Soil.
 4. Immediately install the Stormwater Soil or Planting Soil.
- D. Install the Stormwater Soil or Planting Soil in 12 - 18 inch lifts to the required depths. Apply compacting forces to each lift as required to attain the required compaction. Scarify the top of each lift prior to adding more Stormwater Soil or Planting Soil by dragging the teeth of a loader bucket or backhoe across the soil surface to roughen the surface. Note: The 12–18 inch lift requirement for stormwater soil is intentionally larger than the 4–8 inch lifts specified in Sections 310000 and 315000 to avoid over-compaction. The lift requirements of this Section govern for all GSI soil installation.
1. Approved compaction equipment includes a smooth drum roller or plate compactor. Typically one to three passes per lift will achieve the desired compaction. Contractor to test desired compaction methodology with actual soil to be installed to confirm installation method and material properties are compatible and will achieve the specified compaction rates.
 2. Provide adequate equipment to achieve consistent and uniform compaction of the Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction. Use the same equipment and methods of compaction for the entire project

area once soil, installation methodology, and compaction criteria have been coordinated and confirmed.

- E. Do not pass motorized equipment over previously installed and compacted soil except as authorized below.
 - 1. Light weight equipment such as trenching machines or motorized wheel barrows is permitted to pass over finished soil work.
 - 2. If work after the installation and compaction of soil compacts the soil to levels greater than the above requirements, follow the requirements of Over Compaction Reduction herein.
- F. Phase work such that equipment to deliver or grade soil does not have to operate over previously installed Stormwater Soil or Planting Soil. Work in rows of lifts the width of the extension of the bucket on the loader. Install all lifts in one row before proceeding to the next. Work out from the furthest part of each bed from the soil delivery point to the edge of each bed area.
- G. Where travel over installed soil is unavoidable, limit paths of traffic to reduce the impact of compaction in Stormwater Soil or Planting Soil. Each time equipment passes over the installed soil it shall reverse out of the area along the same path with the teeth of the bucket dropped to scarify the soil. Comply with Over Compaction Reduction herein in the event that soil becomes over compacted. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by Owner/Authorized Representative.
- H. Maintain moisture conditions within the Soil during installation or modification to allow for satisfactory compaction.
 - 1. Volumetric soil moisture level during installation shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil texture	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

- 2. The Contractor shall confirm the soil moisture levels with a moisture meter (Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent). Suspend operations if the Soil becomes wet. Apply water if the soil is overly dry.
- I. Installing Stormwater Soil or Planting Soil with soil or mulch blowers or soil slingers is not permitted.

3.5 SOIL COMPACTION REQUIREMENTS

- A. Maintain at the site at all times a soil cone penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
 - 1. Moisture meter shall be "general digital soil moisture meter".

- B. Perform a minimum of one compaction test every 12-inch lift of soil and every 300 square feet of soil installed. Maintain an up-to-date written report of compaction test results. Report shall include the date and time of test, the SMP number, and value reading from the penetrometer. Owner/Authorized Representative may review the written report at any time to confirm conformance with the specification. Submit final compaction and soil moisture report at the completion of soil installation.
- C. The following are threshold levels of compaction as determined by each method for the subsoil surface and full profile of Stormwater Soil or Planting Soil, testing each lift of Soil with a penetrometer. The same penetrometer and moisture meter shall be used to test installed soil throughout the work.
1. Acceptable Compaction
 - a. Standard Proctor Method – 75-85%.
 - b. Penetration Resistance Method – about 75-250 psi.
 2. Soil below 75 psi soil becomes increasingly unstable and will settle excessively.
 3. Unacceptable Compaction
 - a. Standard Proctor Method – Above 85%.
 - b. Penetration Resistance Method – Approximately above 300 psi
 4. Prior to testing the soil with the penetrometer check the soil moisture. Penetrometer readings are impacted by soil moisture and excessively wet or dry soils will read significantly lower or higher than soils at optimum moisture.
 5. The penetrometer readings shall be within 20% plus or minus of the specified levels.
 6. Where the Standard Proctor Method is utilized, the following Bulk Density levels based on 75% minimum and 85% maximum standard Proctor indicate acceptable compaction.

<u>Soil Texture</u>	<u>Bulk Density (g/cm³)</u>	
	Max.	Min.
Loamy Sand	1.80	1.65
Sandy Loam	1.65	1.45
Sandy clay loam	1.55	1.35
Loam	1.50	1.30
Silt Loam	1.45	1.25

3.6 OVER COMPACTION REDUCTION

- A. Any soil that becomes compacted to a density greater than the specified density shall be dug up and reinstalled. This requirement includes compaction caused by other sub-contractors after the Stormwater Soil or Planting Soil is installed and approved.
- B. Surface roto tilling shall not be considered adequate to reduce over compaction at levels 6 inches or greater below finished grade.

3.7 FINE GRADING

- A. Owner/Authorized Representative shall approve all rough grading prior to fine grading.
- B. Grade the finish surface of all planted areas to meet the grades shown on the Drawings.
- C. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat

bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.

- D. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify Owner/Authorized Representative in the event that conditions make it impossible to achieve positive drainage.
- E. Provide smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is one or two inches below all paving surfaces or as directed by the Drawings.

3.8 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
- C. Place erosion control matting over all soil surfaces not stabilized through planting. Erosion control matting to be left in place. See Section 312500 Erosion and Sediment Control for requirements of erosion control matting.

END OF DOCUMENT 3291

SECTION 329200
LAWN AND FINE GRADING

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. Reseeding of existing lawns disturbed during construction.
 - 2. Seeding of new lawns.
 - 3. Maintenance of lawn areas until acceptance.
- B. Related Sections:
 - 1. Division 2 Section "Planting".
 - 2. Division 2 Section "Planting Preparation".

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Topsoil: Native or Imported topsoil. See Soil Preparation section.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

1.4 SUBMITTALS

- A. Submit prior to delivery of materials to site.
 - 1. Submit seed mixes for review.
 - B. Certifications: Submit certificate with names of materials and manufacturer.
 - 1. Ground limestone: Include guaranteed analysis, and weight for packaged material.
 - 2. Commercial fertilizers: Include guaranteed analysis.
 - 3. Seed: include origin of seed.
 - C. Product data: Submit product literature or tear sheets with name of product, and manufacturer.
 - 1. Commercial fertilizer, including type and application rate.
 - D. Source of supply: Submit in writing all proposed sources.
 - E. Test reports: Submit test reports at least three (3) weeks prior to delivery of materials to site.
 - 1. Seed: Test for purity, proportion by weight, weed seed content and germination percentage of all seed mixture proposed for use. No seed shall be delivered until the test reports are approved. All seed shall be tested within six (6) months immediately preceding date of sowing. Seed must comply with all Commonwealth of Pennsylvania seed certifications.
-
- A. Qualification Data: For qualified landscape Installer.
 - B. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 - 1. Experience: Five (5) years' experience in turf installation in projects of similar complexity in addition to requirements in Division 1 Section "Quality Requirements."
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
 - 4. Pesticide Applicator: State licensed, commercial.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged materials: Deliver packaged materials in clearly marked containers showing net weight, guaranteed analysis and name of manufacturer. Specified requirements for packaged materials apply to bulk shipments. Protect materials from deterioration during delivery and during storage at site.
 - 1. Deliver fertilizer and limestone in waterproof bags.

2. All seed shall be labeled to show compliance with requirements of governmental agencies having jurisdiction. All bag tags of seed used shall be retained and if requested, submitted to Owner. Seed shall be kept in dry storage away from contaminants, insects and rodents.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

1.7 PROJECT CONDITIONS

A. Protection of existing conditions adjacent to and within construction zone:

1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
2. All heavy equipment shall be driven or parked on the site only where approved by Owner.
3. Existing pavements, lawns, structures, walls, etc. damaged or disturbed during construction shall be repaired or replaced to the satisfaction of the Owner.
4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.
5. Avoid damaging existing trees. Damage includes but is not limited to: cutting, breaking, skinning or compacting of roots, skinning and bruising of bark and breaking of branches and limbs.
 - a. Contractor shall not park or store equipment and supplies within four (4) feet of trunk of existing trees to remain.

B. Environmental requirements:

1. Seed only between April 1 - May 15 and September 1 - October 15, unless otherwise permitted by the Owner.
2. Do not seed during adverse weather, windy conditions or on wet or frozen ground.

PART 2 - PRODUCTS

2.1 SEED

- A. Fresh, clean, new seed. Seed shall be packed in sealed 50 lb. bags showing net weight, composition of mix, date of germination tests and supplier's name. Germination test must be done within a nine-month period prior to sale of the seed.
1. Seed shall not contain in excess of 0.1% by weight weed seed, no more than 1.5% inert matter, and no more than 0.1% other crop seed and no noxious weed seed or undesirable grass species. Comply with state laws governing noxious weeds. Seed containing prohibited or restricted noxious weeds shall not be accepted.
 2. Seed shall be Pennsylvania certified and blue tagged.

- B. Composition of the mix shall be a turf-type tall fescue blend of 60% of at least three (3) varieties of turf-type tall fescue, 30% of Perennial Rye Grass, and no more than 10% Kentucky Bluegrass.

2.2 LIMESTONE

- A. In accordance with soil test recommendations, provide ground, high magnesium limestone containing not less than 85% total carbonates, 95% passing a 20 mesh sieve, 40% passing a 60 mesh sieve and a minimum of 30% percent passing a 100 mesh sieve.

2.3 MULCH

- A. Mulch shall consist of specially prepared wood cellulose processed into a uniform fibrous physical state. Wood cellulose fiber mulch shall be dyed green or contain a green dye in the package that will provide an appropriate color to facilitate visual inspection of the uniformly spread slurry. The fiber mulch, including dye, shall contain no germination or growth inhibiting factors. The mulch material shall be manufactured and processed in such a manner that the wood cellulose fiber mulch will remain in uniform suspension in water under agitation and will blend with other additives to form a homogenous slurry. The mulch material shall form a blotter-like ground cover, on application, having moisture absorption and percolation properties and shall cover and hold grass seed in contact with the soil without inhibiting the growth of the grass seedlings.
- B. Mulch shall contain no elements or compounds at concentration levels that will be phytotoxic. Wood cellulose fiber must conform to the following physical requirements:
 - 1. fiber length to be approximately 10 mm
 - 2. diameter approximately 1 mm
 - 3. pH range of 4.0 to 8.5
 - 4. ash content of 1.6% maximum
 - 5. water holding capacity of 90% minimum
- C. Slope stabilization: in areas where erosion may occur, use an organic tackifier such as CONTACT or an erosion fabric or approved equal, in accordance with manufacturer's instructions.

2.4 WATER

- A. Potable, clean fresh and free from harmful materials. Contractor shall provide all means of conveyance including hoses, sprinklers, tank trucks or other means which may be required to water lawns until accepted by Owner.

2.5 FERTILIZER

- A. A standard complete slow release fertilizer. At least 50% by weight of the nitrogen content of the fertilizer shall be derived from organic materials with the remainder in urea form or equivalent. Fertilizer shall contain percent nitrogen, phosphorous, and potash by weight of ingredients dictated by the topsoil test results.
 - 1. Fertilizer shall be in bags showing weight, analysis, and manufacturer's name

2.6 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

- B. Pre-Emergent and Post-Emergent Herbicides (Selective and Non-Selective) shall only be used with written authorization by the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not work soil in frozen, wet, or muddy conditions.
 - 3. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner and replace with new planting soil as specified in Division 2 Section "Soil Preparation".

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. Grass seed shall be applied to all disturbed areas a result of this project.
- B. Preparation of surface for seeded areas (except within root zones of existing trees):
 - 1. Vertically aerate soil if it has become compacted as a result of construction activities.
 - 2. Prior to applying soil amenities, roll lawn area with a filled water roller. Correct any surface irregularities to prevent formation of low spots.
 - 3. If required by soil test, evenly distribute ground limestone at the recommended rate. Work lightly into the top four (4) inches of topsoil at least one full week prior to applying fertilizer.
 - 4. Spread starter fertilizer uniformly, at the rate determined by soil test for new lawns. Add organic matter 1" deep, if required by soil test.
 - 5. Go over the entire area with a spike drag or rototiller and loosen surface at least 3" deep and then hand rake to a smooth, even surface.

C. Seeding

1. As soon as ground has been properly prepared, sow grass seed at the rate of 6 lbs. per 1,000 sq. ft. total. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
 - a. Use suitable mechanical seeder to sow by hand for small areas.
2. Cover seed with a thin layer of topsoil by light raking.
3. Roll seed in both directions very lightly with an empty water roller.
4. After seed application, apply mulch at a net dry weight of 1,500 lbs. per acre. Mulch shall be mixed with water and the mixture shall contain a maximum of 50 lbs. of wood cellulose fiber per 100 gallons of water. Use a slope stabilizing device in areas where erosion may occur.
5. Water with a fine spray immediately after seeding operations are completed.
 - a. Water all newly installed seeded areas as necessary to keep lawn healthy. Apply water in sufficient quantities so it penetrates four (4) inches into planting soil without puddling. Continue watering until seeded areas are accepted by the Owner.
6. Protect all newly seeded lawn areas from damage.
7. When seeding occurs after acceptable seeding dates, over winter protection shall consist of applying five bales clean straw per 1,000 sq. ft. and anchor mulch by commercial mulch netting or 20 lbs./1,000 sq. ft. cellulose fiber. Asphalt emulsion anchoring is not permitted.

3.4 TURF MAINTENANCE

A. Begin maintenance immediately after each lawn area is restored.

1. All lawn areas shall be watered and kept moist to maximize germination.
 - a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.
 - b. Seed: Water seeded areas as often as required to keep the top 1-inch of soil moist until the seed germinates. Avoid excessive water that will cause the seeds to rot. Once seedlings have germinated and established reduce watering frequency and increase volume for deeper watering. Continually adjust irrigation system until intervals have been stretched to the greatest extent practical.
2. All areas and spots which do not show a prompt catch of grass shall be reseeded and this operation repeated until complete coverage is obtained.
3. When the area does not need to be reseeded, it shall be thoroughly wetted every time the surface shows evidence of drying out and this shall continue through entire period of maintenance.
4. When the average height is 3-4" and the lawn areas are fully germinated, firmly rooted and secure in place, grass shall be cut to 2-3" or 1/3 of the grass blade. Any depressions or irregularities in the lawn surface shall be leveled off and reseeded.
5. Maintenance shall cease after the third mowing, provided all grass areas are properly established and free of washouts, depressions, bare spots, weeds and large off-color areas. If seeding is done in the autumn, the Contractor shall complete the three mowings in the following spring.

6. All lawns shall show a uniform, thick, well-developed stand of grass. If the grass stand is unsatisfactory, the Contractor's maintenance responsibility shall continue until an acceptable stand of grass is achieved.

3.5 SATISFACTORY LAWN

- A. Seed installations shall meet the following criteria as determined by Owner:
 1. Satisfactory Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
 2. Provide at minimum three (3) mowings in accordance with grass height requirements.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.6 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.
- C. Notification signage must be posted at every entrance in a highly visible location at least five (5) days in advance of application and maintained five (5) business days following application, or as recommended by the manufacturer's instructions, whereby it is then removed from the site.
 1. Notification Signage shall be brightly colored, laminated and at least 8.5" by 11" format including the following information:
 - a. Date of Notification.
 - b. Date of Application.
 - c. Name of Chemical.
 - d. Reason for Chemical Application.
 - e. Information informing as to the precautions that must be taken including humans and pets.

3.7 CLEANUP AND PROTECTION

- A. Do not allow soil and debris created by turf work onto permeable unit paving areas. Promptly clean up any soil or debris on impervious paving areas, such as concrete sidewalk or roadway paving. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

- B. Protection of newly planted lawn areas is critical to healthy establishment. Erect temporary protection fencing and warning signs to protect newly planted areas from traffic. Maintain fencing throughout initial maintenance period. Remove protection fencing only after lawn areas have become well established and are able to tolerate regular use. Install temporary protection fencing and signage in accordance with the following:
1. Temporary Protection Fencing
 - a. Fencing shall cordon off the entire perimeter of lawn area to prevent access.
 - b. Fencing shall be supported securely as required to remain erect for duration of site protection. Utilize heavy-duty 12 gauge minimum metal fence posts spaced at 6 to 8 feet on center, or as required. Posts shall be driven into the soil sufficient depth to support fencing against heavy wind load.
 - c. Fencing shall be at least 4-foot high. Secure fencing to posts at the top and bottom and in at least one location in the middle with zip or cable ties. Fencing may also be woven through each post and secured at the top only with a zip tie.
 2. Signage: Notification signage shall be brightly colored, laminated and at least 8.5" by 11" format attached to fencing every 10 to 12 feet, including the following information.
 - a. "Please keep off lawn areas. Lawn will be available once protection fencing has been removed."
- C. If utilized, remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 329300

PLANTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Provide trees, shrubs, perennials, grasses and groundcover and all necessary accessories.
 - 2. Maintenance and replacement during Establishment Period.

1.2 RELATED SECTIONS

- A. Section 329100 – Planting Preparation

1.3 REFERENCES

- A. The following apply to work in this Section:
 - 1. ASNS: "American Standard for Nursery Stock," latest edition, published by the American Nursery and Landscape Association.
 - 2. NAA: "National Arborist Association Standards for Pruning", latest edition, published by the National Arborist Association.
 - 3. ANSI: "American National Standards Institute", latest edition.

1.4 SUBMITTALS

- A. Certifications: Submit certificate with names of materials and manufacturer.
 - 1. Plants: Furnish certificates of inspection as may be required by Federal, State or other authorities that plants are free of disease or hazardous insects.
 - 2. Commercial fertilizers: Include guaranteed analysis.
 - 3. Ground limestone: include guaranteed analysis and weight for packaged material.
 - 4. Commercial fertilizers: include guaranteed analysis.
- B. Instructions: Submit planting and maintenance schedule.
 - 1. Submit the proposed planting installation schedule indicating dates for tagging and installation, dates and duration of plant storage at an off-site location, and a detailed program of Establishment Period maintenance.
- C. Product data: Submit product literature or tear sheets with name of product, and manufacturer.
 - 1. Commercial fertilizer.
 - 2. Mulch.

- E. Samples: Submit loose materials in sealed bags labeled with name of material and manufacturer.
 - 1. Mulch, 1/2 lb. bag.
- F. Source of supply: Submit in writing all proposed sources.
 - 1. Locate trees and make all pre-selection arrangements at the source of supply required to ensure an efficient selection procedure. Landscape Architect, with Contractor present, will select plants at nursery on the basis of their compliance with the Drawings. Contractor shall inspect the selected plants on the basis that the plants are free of disease and otherwise conform to the requirements of the Contract Documents. The accuracy of the varieties of species specified for plant material shall be the Contractor's responsibility. Request visit at least 14 days in advance of desired inspection date.
 - a. Trees will be inspected and approval given by Landscape Architect at the source for conformity to Specification requirements. Such approval shall not affect the right of inspection and rejection during delivery and installation.
 - b. All trees specified as B&B must be in the ground at the growing source at the time of inspection. Pre-dug trees shall not be acceptable.

1.5 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with planting installation and general construction techniques under the supervision of an experienced landscape foreperson.
- B. Plants: Meet or exceed applicable AAN standards.
 - 1. Plant List: Investigate sources of supply prior to submitting bid. Confirm that size, variety and quantity of plants specified on Plant List can be supplied. Failure to take this precaution shall not relieve the successful bidder from responsibility for furnishing and installing all plants in strict accordance with Contract requirements.
 - a. Substitutions shall not be permitted unless substantiated written proof is supplied that a specified plant is not obtainable. In this situation a proposal to use the nearest equivalent size or variety with an equitable adjustment of Contract Price will be considered.
 - b. Plant substitutions will be permitted only upon approval by the Owner and Landscape Architect.
 - c. All plants shall be grown on their own roots. No grafted species shall be acceptable.
 - d. Plants shall be of the quantity and quality indicated, true to name, properly labeled with botanical name and in accordance with the sizes and grades specified.

1.6 PROJECT CONDITIONS

- A. Protection of existing conditions adjacent to and within construction zone:
 - 1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
 - 2. All heavy equipment shall be driven or parked on the site only where approved by Owner.

3. Existing pavements, structures, walls, etc. damaged or disturbed during construction shall be repaired or replaced to the satisfaction of the Owner.
4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.
5. Avoid damaging existing trees. Damage includes but is not limited to: cutting, breaking, skinning or compacting of roots, skinning and bruising of bark and breaking of branches and limbs.
 - a. Contractor shall not park or store equipment and supplies within four (4) feet of trunk of existing trees to remain.

B. Environmental requirements:

1. Plant only within the following dates, weather permitting. Do not plant when ground is frozen, when the soil is excessively wet, when ambient air temperature exceeds 85 degrees or in otherwise unsatisfactory weather conditions.
 - a. Plant between March 1 and June 15 and August 15 until the ground freezes.
 - b. Plant trees known to be fall digging hazards only in the Spring.
2. Chemical Spraying Program: no spraying of herbicides, insecticides, fungicides, nematicides, fumigants or other chemicals shall be done without first submitting a spray program to the Owner.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Packaged materials: Deliver packaged materials in clearly marked containers showing net weight, guaranteed analysis and name of manufacturer. Specified requirements for packaged materials apply to bulk shipments. Protect materials from deterioration during delivery and during storage at site.
1. Deliver fertilizer in waterproof bags.
 2. All seed shall be labeled to show compliance with requirements of governmental agencies having jurisdiction. All bag tags of seed used shall be retained and if requested, submitted to Owner. Seed shall be kept in dry storage away from contaminants, insects and rodents.
- B. Plants: Notify Owner seven (7) days in advance of any delivery of plants to site.
1. Dig and handle trees with care to prevent injury to trunks, branches and roots. Do not prune prior to delivery. Do not bend or bind-tie trees in such manner as to damage bark, break branches or destroy natural shape. Pack and ship to ensure arrival at site in good condition. Provide protective covering during delivery. Plants with cracked or broken root balls shall not be accepted.
 2. Deliver plants after preparation of planting areas has been completed and approved, install plants immediately.
 - a. If planting is delayed more than eight (8) hours after delivery, set balled and burlapped plants on the ground well protected with soil, wet mulch or other acceptable material. Protect balls and roots, and container grown material from freezing, sun, drying winds and/or mechanical damage. Water as necessary until planted.
 - b. Do not heel in plants for more than five business days.
 3. Immediately remove rejected plants from site.

1.8 INSPECTION FOR SUBSTANTIAL COMPLETION

A. Plants:

1. All plants shall be alive, healthy and installed to be accepted.
2. Guarantee Period for plants shall not begin until all items have been completed or corrected.

1.9 GUARANTEE / ESTABLISHMENT PERIOD FOR PLANTS

- A. Contractor shall not be held responsible for acts of vandalism occurring after the beginning of Guarantee Period, nor shall Contractor be held responsible for deleterious effects caused by maintenance procedures performed by Owner without concurrence of Contractor.
- B. Replace at no additional cost for a period of two growing seasons after the beginning date of Guarantee Period, any plants that have died or that are, in the opinion of Owner, in unhealthy or unsightly condition, or that have lost their natural shape due to dead branches, excessive pruning, excessive defoliation.
 1. A growing season is defined as the period during which plant growth takes place from last killing frost of Spring to the first killing frost of Autumn.
 2. Replace unacceptable plants no later than the next succeeding planting season. All replacements shall have a guarantee of one planting season from date of replacement.
 - a. Replace unacceptable plants in accordance with original Specification. Cost is considered to be included in the Bid and Contract Price.

PART 2 PRODUCTS

2.1 PLANTS

- A. Provide freshly dug plants nursery grown in accordance with good horticultural practice.
 1. Sound, healthy and vigorous, well-branched and fully foliated when in leaf, free from disease, insect pests, eggs or larvae with healthy well-developed root systems.
- B. Conform to measurements specified on Plant List. Plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants shall be in accordance with standards specified in ASNS and conform to ANSI Z.60.1.
- C. Provide B&B stock with a compact natural ball of earth, firmly wrapped and tied in burlap so that upon delivery the soil in the ball is still firm and compact about the small feeding roots. Root ball sizes shall be in accordance with standards specified in ASNS.
- D. Furnish trees with rootballs measured from top of rootball which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before trees are dug to ensure proper rootball depth.

- E. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to the Owner and Landscape Architect, with a proportionate increase in the size of roots or balls.
- F. Plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants shall be in accordance with standards specified in ASNS.

2.2 STAKING AND GUYING MATERIALS

- A. Tree Stakes: 2" x 2" x 8' long wood posts, minimum 2 per tree, if required.
- B. Guys: Nylon straps shall be used wrapped loosely around tree trunks and securely fastened to stakes.

2.3 LIMESTONE

- A. In accordance with soil test recommendations, provide ground, high magnesium limestone containing not less than 85% total carbonates, 95% passing a 20 mesh sieve, 40% passing a 60 mesh sieve and a minimum of 30% percent passing a 100 mesh sieve.

2.4 MULCH

- A. Double shredded hardwood bark. To be natural in color, free of dye.

2.5 WATER

- A. Potable, clean fresh and free from harmful materials.

2.6 HERBICIDES

- A. Herbicides, fungicides, and pesticides: Approved before use for type and rate of application by Owner and local, state and/or federal agencies with jurisdiction. Spraying of all herbicides shall be done in accordance with the Chemical Spraying Program.
 - 1. Non-selective herbicide shall be Round-Up as manufactured by Monsanto or approved equal.

2.7 FERTILIZER

- B. A standard complete slow release fertilizer. At least 50% by weight of the nitrogen content of the fertilizer shall be derived from organic materials with the remainder in urea form or equivalent. Fertilizer shall contain percent nitrogen, phosphorous, and potash by weight of ingredients dictated by the topsoil test results.

1. Fertilizer shall be in bags showing weight, analysis, and manufacturer's name.

2.8 PROTECTION MATERIALS

- A. Wood stakes, suitable in length so that 30" minimally is exposed above ground.
- B. Durable twine with fluorescent flagging.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that previously installed protection measures are in place.
- B. Verify that excavation and grading is complete.
- C. Do not begin planting and lawn work until all other work is complete. Planting areas shall be free of waste and debris generated by other construction activities.
- D. Beginning installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees from damage caused by seeding operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Planting Pits:
 1. Verify by testing that planting areas are free draining. If planting areas are not free draining notify Owner and submit alternative method of drainage for approval.
 2. Stake out location of trees.
 - a. Locate and mark all subsurface utilities lines.
 - b. Completely layout planting areas before seeking approval by Landscape Architect and Owner.
 3. Planting pits in plant beds shall be excavated to the depth of the rootball and to the width shown on the Drawings. Trees shall be planted on undisturbed soil. If the planting pit is initially dug too deep, the soil to bring it up to the correct level should be thoroughly tamped.
 - a. Tree pit excavations shall be circular and the sides of the excavation shall slope at 45 degrees. The bottom of the planting pit shall be level such that the tree sits plumb.
 - b. Install 18" of planting soil continuously in plant beds or as indicated on Drawings.

4. Remove all existing materials from tree pits and scarify bottom and sides of planting pits and beds.
5. If an impervious hard plan layer exists in the bottom of the pit after excavation, the pits shall be excavated to the depth of the hardpan or 36 inches below the bottom of the ball. Pit shall then receive a 6 inch layer of AASHTO 57 stone, covered with straw or similar material. Remainder of pit shall be backfilled with topsoil as specified.

3.3 PLANT INSTALLATION

A. Planting:

1. Do not plant until trees and planting pits have been approved by Owner and Landscape Architect.
2. Plant trees to a depth such that the bottom of the trunk flare is 1" above finished grade.
3. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
4. Plant upright and plumb and faced to give the best appearance or relationship to adjacent plants and structures.
5. Do not pull burlap out from under balls. Remove platforms, wire and surplus binding to the greatest extent possible. Remove burlap from the top and sides of the rootball to the greatest extent possible. Cleanly cut off all broken or frayed roots.
6. Set container grown stock plumb and in center of planting pit or trench with root flare above adjacent finished grades per Drawings.
 - a. Carefully remove root ball from container without damaging root ball or plant .
 - b. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. For large shrubs, when planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - c. Continue backfilling process. Water again after placing and tamping final layer of soil.
7. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
8. Remove all non-biodegradable materials from the planting area.
9. Carefully place planting soil in six (6) inch lifts to avoid injury to roots and to fill all voids. Tamp each lift with foot pressure sufficient enough to prevent settlement or shifting.
10. When the planting area is nearly filled, water and allow to soak away. If planting soil settles after watering, add more planting soil to bring to required level.
11. Upon completion of planting operations, water plants thoroughly over the entire planting bed until fully saturated.
 - a. Apply water slowly to ensure penetration into the entire root system.
12. Mulch within two (2) days of planting. Install two (2) inches of mulch over tree rootballs, and continuously over entire planting beds. Keep mulch at least 2 inches away from tree trunk.
13. Staking and guying shall be done immediately after trees are planted. Trees shall stand plumb after staking.
 - a. Provide a minimum of two (2) stakes per tree.

14. Neatly prune trees to remove broken or badly bruised branches with a clean cut in accordance with NAA standards, and at the time designated by, and to the satisfaction of Owner.
 - a. Preserve the plant's natural character,
 - b. Perform pruning with clean, sharp tools.

3.4 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

- A. Begin maintenance immediately after each planting area is installed.
 1. Provide all care necessary to keep trees healthy including but not limited to: watering, mulching, weeding, fertilizing, pruning and spraying.
 2. During periods of inadequate rainfall, as determined by the Owner, all plants shall be watered to maintain a constant suitable moisture level for good plant growth. Contractor shall provide all watering hoses and devices. Owner will provide water source.
 3. Weed control shall be by mechanical or hand weeding.
 4. Use of herbicides, insecticides, fungicides, nematocides, fumigants or other chemicals are only acceptable upon approval by the Owner.
- B. Prior to inspection for Substantial Completion remove all excess soil and debris from site and repair damage resulting from planting operations.

3.5 PLANT GUARANTEE / ESTABLISHMENT PERIOD

- A. The Establishment Period will begin upon notice of substantial completion by the Owner.
- B. Contractor shall guarantee the plants against defects including death and unsatisfactory growth. Guarantee shall include the purchase of the plants, the rental of any required special equipment necessary to place the plants and the installation of the plants. Contractor shall not be liable for vandalism out of Contractor's control.
- C. New plants installed during the Establishment Period shall carry a new establishment period guarantee equal to the original that begins at the time of acceptance of the replacements plant(s). Replacement and repair work shall be re-inspected by the Owner.
- D. At the end of the Plant Establishment Period, Owner shall make an inspection to determine that all plants are living and healthy. Any replacement of plants at this time shall be made according to the specifications for that type of plant. New plants installed as part of the original two-year guarantee, shall carry a new one-year guarantee period that begins at the time of acceptance of the replacement plant(s). Any replacement and repair work that is required shall be re-inspected by the Owner.

3.6 PLANT MAINTENANCE DURING ESTABLISHMENT PERIOD

- A. General: Perform procedures set forth in the submitted and approved maintenance program for the duration of Guarantee Period.

1. Inspect all plants at least once a month to locate any disease or pest infestations. If infestation is present, submit a proposed method of control to Owner for approval prior to application of control measures.
2. Remove dead plants within five (5) business days of notification by Owner or the Owner will remove the plants and bill the Contractor accordingly.
 - a. Replacement plants may be installed during the next appropriate planting season.
 - b. Replacement plants shall be of the same species and size as specified in the Plant List.
3. Perform all maintenance procedures, including but not limited to: fertilizing, watering, weeding, and mulching.
 - a. Prune, as necessary, to remove dead, diseased and damaged branches.
 - b. During periods of inadequate rainfall, all plants shall be watered to maintain a constant suitable moisture level for adequate plant growth. Apply water slowly so as to penetrate the entire root zone. Contractor shall provide water hoses. The Owner shall provide the water source.
 - c. Completely remove, by hand pulling, all weeds within mulch areas. Under no circumstances are weeds to attain more than two (2) inches of growth. Herbicide use is acceptable with Owner approval.
 - d. Restore mulch around trees as necessary to preserve their appearance and to control weed growth.
 - e. If refertilizing of trees is required, apply Ra-Pid-Gro at manufacturer's suggested rate.
 - f. If any tree settles from its proper elevation, raise it to the proper level.
 - g. If spraying to control insects, fungus, and other diseases is required seek approval from Owner before spraying. Furnish a spray program and product information on all sprays to be used to Owner for approval. After approval, application will only be permitted by licensed applicators. Applicators shall follow Notification requirements and report any Chemical Hypersensitivity Registries for the area.

3.7 FINAL ACCEPTANCE

- A. At end of Establishment Period, submit a written request to the Owner for Inspection for Final Acceptance at least two (2) weeks prior to the day on which inspection is requested.
- B. At the end of the Establishment Period, Owner and Contractor shall make an inspection to determine that all plants are living and healthy. Any plant that is dead or not in satisfactory condition, as determined by the Owner, shall be removed from the site and replaced in accordance with the specifications.

END OF SECTION 329300

SECTION 330561 – CONCRETE MANHOLES
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories, as applicable to the outlet control structure specified in Section 334616 – Stormwater Control Structures and any other manhole structures shown on the Drawings.
2. Bedding and cover materials.

B. Related Requirements:

1. Section 310000 - Earthwork.
2. Section 334616 – Stormwater Control Structures.
3. Section 334200 – Stormwater Conveyance.

1.2 DEFINITIONS

- A. Bedding:** Specialized material placed under manhole prior to installation and subsequent backfill operations.

1.3 REFERENCE STANDARDS

A. American Association of State Highway Transportation Officials:

1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C55 - Standard Specification for Concrete Building Brick.
4. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
5. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
6. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.

7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
10. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
11. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

- D. Philadelphia Water Department (PWD): Standard Specifications and Standard Details (most recent revision or amendment).

1.4 COORDINATION

- A. Coordinate Work of this Section with connection to stormwater conveyance, site sanitary sewerage gravity piping, and trenching.

1.5 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.
- B. Shop Drawings:
 1. Indicate structure locations and elevations.
 2. Indicate sizes and elevations of piping, conduit, penetrations, and rim elevation.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.8 QUALITY ASSURANCE

- A. Perform Work according to Philadelphia Water Department Standard Specifications and Standard Details (most recent revision or amendment) and City of Philadelphia standards.
- B. Maintain one copy of each standard affecting Work of this Section on Site.

- C. All gray and ductile iron castings (manhole covers, frames, grates) shall be furnished by a supplier pre-qualified per Philadelphia Water Department QC-2 Standards for Gray/Ductile Iron Castings, consistent with Sections 334200 and 334616.

1.9 QUALIFICATIONS

- A. Manufacturer:

- 1. Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
 - 2. Listed on PennDOT Bulletin 15.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Handling: Comply with precast concrete manufacturer instructions for unloading and moving precast manholes and drainage structures.
- C. Storage:

- 1. Store materials according to manufacturer instructions.
 - 2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
 - 3. Repair property damaged from materials storage.

- D. Protection:

- 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

- A. Cold Weather Requirements: Comply with ACI 530/530.1.

1.12 EXISTING CONDITIONS

- A. Field Measurements:

- 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

- A. Furnish five-year manufacturer's warranty for concrete manholes.

PART 2 - PRODUCTS

2.1 CONCRETE AND MASONRY MANHOLES

A. Manufacturers:

1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Manhole Sections:

1. Materials:

- a. Reinforced Precast Concrete: Comply with ASTM C478.
- b. Gaskets: Comply with ASTM C923.

2. Joints:

- a. Comply with ASTM C913.
- b. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

C. Mortar and Grout:

1. Mortar:

- a. As specified in PennDOT Publication 408, Section 705.7(b).

2. Grout: As specified in PennDOT Publication 408, Section 1001.2(d).

D. Reinforcement:

1. As specified in PennDOT Publication 408, Section 709.

E. Clear Inside Dimensions:

1. Diameter: 48 inches.

F. Design Depth:

1. As indicated on Drawings.

G. Clear Cover Opening:

1. Diameter: 26 inches.

- H. Pipe Entry: Furnish openings as required.
- I. Structure Joint Gaskets:

- 1. Provide rubber gaskets per ASTM C443 or Neoprene gaskets per ASTM C361 as specified in PennDOT Publication 408, Section 705.5(b)3.

2.2 FRAMES AND COVERS

A. Manufacturers:

- 1. Furnish materials from a source listed in PennDOT Bulletin 15.
 - 2. Casting supplier shall be pre-qualified per PWD QC-2 Standards for Gray/Ductile Iron Castings.

B. Description:

- 1. Material:
 - a. Cast iron.
 - b. Comply with AASHTO M306.
 - 2. Lid:
 - a. Bearing Surface: Machined flat.
 - b. Configuration: Removable.
 - c. Security: Bolt-down or requiring special tool to open, in accordance with PWD standard practice for accessible structures in public areas. Confirm required security type and locking configuration with PWD prior to procurement.
 - 3. Cover Design: Closed.
 - 4. Live-Load Rating: HS-25.
 - 5. Furnish sealing gasket complying with ASTM C990.
 - 6. Cover: Molded with identifying name.
 - 7. Nominal Lid Size: 26 inches diameter.

2.3 GRADE ADJUSTMENT RINGS

A. Manufacturers:

- 1. Furnish materials from a source listed in PennDOT Bulletin 15.

B. Riser Rings:

- 1. Thickness of 2 to 12 Inches:
 - a. Precast concrete.

- b. Comply with PennDOT Publication 408, Section 605.2(d).
- c. A maximum of two grade adjustment rings are permitted for grade adjustment. Total depth of rings is limited to 12" maximum.

2.4 MATERIALS

A. Cover and Bedding:

- 1. Bedding: Construct manholes on a subbase constructed of compacted No. 2A coarse aggregate. Place in 4" layers to provide a 12" minimum depth.
- 2. Cover: Backfill excavated spaces around the structure with acceptable embankment material.

2.5 ACCESSORIES

- A. Steps: As specified in PennDOT Publication 408, Section 605.2(c) and from a manufacturer listed in PennDOT Bulletin 15. ("605(c)" corrected to "605.2(c).")
- B. Joint Sealant: Comply with ASTM C990.
- C. Grout: Non-Shrink as specified PennDOT Publication 408, Section 1080.2(c).

2.6 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.
- B. Certificate of Compliance:
 - 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location and are ready for roughing into Work.
- C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.
- C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

- D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- B. Correct over-excavation with coarse aggregate.
- C. Remove large stones or other hard matter impeding consistent backfilling or compaction.
- D. Protect manhole from damage or displacement while backfilling operation is in progress.
- E. Excavating:
 - 1. As specified in Section 310000 – Earthwork and in indicated locations and depths.
 - 2. Provide clearance around sidewalls of manhole or structure for construction operations.
 - 3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
 - 4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Architect/Engineer.
- F. Base and Alignment:
 - 1. Install manholes supported at proper grade and alignment on compacted crushed-stone bedding.
 - 2. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.
 - 3. Form and place manhole or structure cylinders plumb and level, to correct dimensions and elevations.
- G. Attachments:
 - 1. As Work progresses, build fabricated metal items and steps.
 - 2. Cut and fit for pipe.
 - 3. Set cover frames and covers level to correct elevations without tipping.
- H. Backfilling: As specified in Section 310000 - Earthwork.
- I. Precast Concrete Manholes:
 - 1. Lift precast components at lifting points designated by manufacturer.
 - 2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
 - 3. Assembly:
 - a. Assemble multisection manholes and structures by lowering each section into excavation.
 - b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
 - c. Lower, set level, and firmly position base section before placing additional sections.

4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed manholes meet required alignment and grade.
8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
9. Cut pipe flush with interior of structure.
10. Shape inverts through manhole as indicated on Drawings.

J. Castings:

1. Set frame and cover 2 inches above finished grade for manholes and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame. Note: If the outlet control structure cover is located within a paved or hardscape area, set frame flush to finished pavement grade. Confirm setting elevation with the grading plan prior to installation.

3.4 ADJUSTING

A. Vertical Adjustment of Existing Manholes and Structures:

1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
2. Frames, Grates, and Covers:
 - a. Remove frames, grates, and covers cleaned of mortar fragments.
 - b. Reset to required elevation according to requirements specified for installation of castings.

3.5 CONSTRUCTION CERTIFICATION FORM

- A. The contractor shall fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor shall make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
 1. Professional Engineer
 2. Registered Architect
 3. Landscape Architect
 4. Professional Land Surveyor
 5. Professional Geologist
 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP component, including the outlet control structure. The SMP installation must be observed by the PWD Inspector.

- D. Do not backfill or cover the outlet control structure until the PWD Inspector has completed observation and documentation as required by the CCP.

END OF SECTION 330561

SECTION 331416 – SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section includes water-distribution piping and related appurtenances for site work to be picked up by the general site contractor 5' from the face of all buildings.
- B. All work shall conform to the requirements of Philadelphia Water, Philadelphia Fire Marshall, and any other regulatory authorities having jurisdiction.
- C. All water main work and water service connections under this contract shall be governed by and done in accordance with the most recent revision or amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department.
- D. All work on water service connections shall be done by, or under the direction of, a licensed Master Plumber.
- E. Section Includes:
 - 1. Pipe and fittings for Site water line, including domestic water line and fire water line.
 - 2. Tapping sleeves and valves.
 - 3. Valves and boxes.
 - 4. Reduced-pressure backflow preventers and enclosures.
 - 5. Pipe support systems.
 - 6. Bedding and cover materials.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirements:
 - 1. Section 033053 – Site Cast-in-Place Concrete: Concrete for thrust restraints.
 - 2. Section 310000 – Earthwork.
 - 3. Section 312316.13 – Trenching: Execution requirements for trenching.
 - 4. Section 331419 – Valves and Hydrants for Water Utility Service.

1.3 REFERENCES

- A. Philadelphia Water Department (PWD)
 - 1. Standard Details
 - 2. Standard Specifications
- B. Factory Mutual (FM)
 - 1. Approval Guide
- C. Underwriters Laboratories (UL)
 - 1. Fire Protection Equipment Directory
 - 2. UL 1285 - Pipe and Couplings, Polyvinyl Chloride (PVC), for Underground Fire Service
 - 3. UL 262 - Gate Valves for Fire-Protection Service

4. UL 246 - Hydrants for Fire-Protection Service
- D. National Sanitation Foundation (NSF)
1. NSF 14 - Plastics Piping System Components and Related Materials
 2. NSF 61 - Drinking Water System Components - Health Effects
- E. National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code
 2. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances (new standard)
 3. NFPA 1963 - Screw Threads and Gaskets for Fire Hose Connections (revision of ANSI/NFPA 1963-1993)
- F. American Water Works Association (AWWA)
1. C151 Ductile-Iron Pipe, Centrifugally Cast, for Water (revision of ANSI/AWWA C151/A21.51-91)
 2. C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 3. C150 - Thickness Design of Ductile-Iron Pipe
 4. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids
 5. C153 - Ductile-Iron Compact Fittings, 3 in. through 24 in. (76 mm Through 610 mm) and 54 in. through 64 in. (1,400 mm Through 1,600 mm), for Water Service
 6. C500 - Gate Valves for Water and Sewage Systems
 7. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 8. C550 - Protective Epoxy Interior Coatings for Valves and Hydrants
 9. C509 - Resilient-Seated Gate Valves for Water Supply Service
 10. C800 - Underground Service Line Valves and Fittings
 11. C702 - Cold Water Meters - Compound Type
 12. C502 - Hydrants, Dry Barrel Fire
 13. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
 14. C605 - Water Treatment - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water
 15. C651 - Disinfecting Water Mains
- G. American Society for Testing and Materials (ASTM)
1. B88 - Standard Specification for Seamless Copper Water Tube
 2. B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
 3. B32 - Standard Specification for Solder Metal
 4. D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 5. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Piping Systems
- H. American Society of Mechanical Engineers (ASME)
1. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings R(1994)
 2. B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- I. Manufacturer's Standardization Society (MSS)
1. MSS SP-60 – Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.

1.4 SUBMITTALS

- A. Product Data for the following:
 - 1. Valves, Corporation Stops, Curb Boxes, Curb Stops, Valve Boxes
 - 2. Backflow preventers and assemblies, including enclosure
 - 3. Meter Pits
 - 4. Fire Hydrants
- B. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data for the following:
 - 1. Valves;
 - 2. Backflow preventers;
 - 3. Protective enclosures; and,

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of the regulatory authorities having jurisdiction; including tapping of water mains, backflow prevention, installation, testing, and disinfection. Comply with standards of the regulatory authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: UL listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the regulatory authorities having jurisdiction and marked for intended use.
- D. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance: Comply with NSF 14 for plastic potable-water-service piping. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
- G. Suppliers of materials must be pre-qualified in accordance with Water Department Quality Certification Standards QC-1 for Precast Concrete Products, QC-2 for Gray/Ductile Iron Castings, QC-3 for Ready-Mixed Concrete, QC-4 for Welded Steel Inlet Frames and Grates, QC-5 for Standard Pressure Fire Hydrants, QC-6 for Reinforced Concrete Pipe, QC-7 for Filter Media Products, QC-8 for Ductile Iron Pipe and Fittings, QC-9 for Vitrified Clay Pipe and Fittings, QC-10 for Standard Pressure Gate valves (3" to 12") & (16" & Larger), QC-11 for Standard Pressure Butterfly Valves (3" to 20") & (24" & Larger), QC-12 for Resilient-Seated Gates Valves (3" to 12" Dia. & 16" Dia. to 48"), and QC-13 for Thermoplastic Pipe and Fittings.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify the engineer and the Owner not less than 2 days in advance of proposed utility interruptions; and,
 - 2. Do not proceed with utility interruptions without written permission from the engineer or the Owner.

1.7 COORDINATION & FEES

- A. The Contractor shall be responsible for obtaining and payment of all tap and construction permit fees associated with this section.
- B. The Contractor shall install water lines and appurtenances as shown on the drawings. Including, but not limited to, any taps, vault, and backflow prevention. The Contractor shall install plugging and marking apparatus as necessary to protect his work. Water meters are furnished and installed by the Philadelphia Water Department. The cost is covered in the fee charged for a water permit. Contractor is to coordinate with Philadelphia Water for meter installation.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS, APPLICATION

- A. Ductile-Iron Pipe
 - 1. Ductile iron pipe shall conform to the requirements of AWWA C151, class 350, and shall have a cement-mortar lining of standard thickness in accordance with AWWA C104; pipe thickness shall be in accordance with AWWA C150; pipe shall have push-on joints in accordance with AWWA C110. Additional fittings shall be mechanical-joint ductile-iron compact fittings in accordance with AWWA C153 or standard size in accordance with AWWA C110.
 - 2. Cast into, stamp or paint on each pipe: the manufacturer's mark; casting number; year of cast; "DI"; class of pipe. Markings shall be clear and legible.
- B. Copper Tubing
 - 1. Comply with ASTM B88.
 - 2. Type: K, annealed.
 - 3. Fitting: Cast copper; ASME B16.18
 - 4. Joints: Compression connection.

2.2 VALVES

- A. Cast-Iron, Gate Valves:
 - 1. Nonrising-Stem, Metal-Seated Gate Valves: AWWA C500, UL 262, FM-approved, gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - a. Minimum Working Pressure: 200 psi (1380 kPa).
 - b. End Connections: Mechanical joint, per (AWWA C 111).
 - c. Interior Coating: Complying with AWWA C550.

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- d. Nut: 2 inches square, complying with AWWA C500.
 - 2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, UL 262, FM-approved, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - a. Minimum Working Pressure: 200 psig (1380 kPa).
 - b. End Connections: Mechanical joint, per ANSI A21.11 (AWWA C111).
 - c. Interior Coating: Complying with AWWA C550.
 - d. Nut: 2-inch square, complying with AWWA C500.
 - B. Tapping-Sleeve Assemblies: Conform to the requirements of MSS SP-60. Tapping sleeves may be cast-iron, ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection.
 - C. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, lid with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch diameter barrel.
 - D. Operating Wrenches: Steel tee-handle, stem of length to operate deepest buried valve, and 2-inch square socket matching valve operating nut, placed in sprinkler room.
- 2.3 WATER SERVICE CONNECTIONS
- A. Service-Saddle Assemblies: Comply with AWWA C800.
 - B. Corporation Valve: Comply with AWWA C800, bronze body, threaded inlet and outlet matching service piping material.
 - C. Buffalo type curb boxes or approved equal
 - D. Curb Stops: Comply with AWWA C800, bronze body, with inlet and outlet matching service piping material.
 - E. Copper service pipe in accordance with ASTM B 88, Type K, annealed (temper O50 or O60).
- 2.4 METER PIT
- A. Meter pits and accessories shall be tested and registered with the quality certification staff in accordance with the quality certification standard QC-1 for precast concrete products.
 - B. Meter pit shall be designed for H-20 loading.
 - C. All precast segments shall be keyed and their joints watertight.
 - D. Precast Concrete Meter Pit:
 - 1. Precast manufacturers shall be certified in accordance with QC-1 by the Department Quality Certification Staff.
 - 2. Concrete shall consist of Portland Cement which conforms to ASTM C150 and aggregates which conform to C33. The minimum compressive strength shall be 4,000 psi.
 - 3. Reinforcing steel shall conform to ASTM A615 grade 60 for bars or ASTM A185 for welded wire fabric.

2.5 BACKFLOW-PREVENTION DEVICES

- A. Comply with regulatory authorities having jurisdiction requirements and as shown on the Drawings.
- B. Enclosure:
 - 1. Provide manufactured backflow prevention assembly enclosure meeting the requirements of the backflow preventer and ASSE 1060.
 - 2. Enclosure shall be installed on a Concrete Pad meeting the manufacturer's instructions and meeting the requirements of Section 033053 – Site Cast-in-Place Concrete.

PART 3 - EXECUTION

3.1 TRENCHING

- A. Comply with requirements of Section 312316.13, Trenching.

3.2 VALVES

- A. General Application: Use mechanical joint valves for NPS 2-inch and larger underground installation. Use threaded or flanged-end valves for installation in vaults.
- B. Set Valve boxes to grade, true and plumb with valve operating nut centered in box.

3.3 PIPE AND FITTING INSTALLATION

- A. Water-Main Connection: Verify with regulatory authorities having jurisdiction that size of tap and location shown on drawings is acceptable. Make tap conforming to requirements of regulatory authorities having jurisdiction and Manufacturers Standardization Society (MSS) standards.
- B. Install each service pipe with the material specified, or as directed by the Project Manager.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- E. All piping shall be installed with a minimum of 4 feet of cover, or 12 inches below level of max frost penetration, or as required by regulatory authorities having jurisdiction, whichever is deeper. If pipe is installed in a cut section prior to completion of grading operations, pipe shall be installed so that minimum required cover will exist upon completion of grading operations.
- F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- G. Pipe Bedding: Pipe bedding material shall be installed if required by regulatory authorities having jurisdiction water authority or engineer. No pipe shall be laid resting on a rock, blocking or unyielding objects.

- H. Location with Sewers: Separate trenches shall be provided for water lines and sewer lines, with lines separated by a minimum of 10 feet horizontally. Water mains that cross sewers shall have a minimum vertical separation of 18 inches).
- I. Tap water main for installation of ferrule. Use a single piece of service pipe between ferrule or swing joint and curb stop. Connect new service to water distribution pipe. Where adapter is required between curb stop and water distribution pipe, length of adapter may not exceed two feet without written approval from Project Manager for each such connection.

3.4 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600;
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23;
 - 3. Fire-Service-Main Piping: According to NFPA 24; and,
 - 4. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 BACKFLOW-PREVENTER INSTALLATION

- A. Comply with regulatory authorities having jurisdiction, including Philadelphia Water Department requirements.
- B. Do not install bypass piping around backflow preventers.

3.6 QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests:
 - 1. The Contractor shall test all pipelines and appurtenances with water at test pressure of 150 psi or 1.5 times working pressure, whichever is greater. Test pressure must be maintained for at least 2 hours. All leakage apparent after testing must be repaired immediately.
 - a. The work will not be finally accepted until leakage shall prove to be less than 10 gallons per 24 hours per mile of pipe at test pressure; and,
 - 2. Fire Water System tests shall be in full conformity with the requirements of all applicable codes, NFPA standards, and other authorities having jurisdiction.
 - a. All new underground mains and lead-ins shall be flushed thoroughly before connection is made to internal system piping. The site utility subcontractor shall be responsible for disposal of the test water drained from the test outlets.
 - b. The trench shall be backfilled between joints before testing to prevent movement of pipe.
 - c. Test shall be made by the site utility subcontractor in the presence of the regulatory authority having jurisdiction and/or the Owner's representative.
 - d. The site utility subcontractor shall prepare reports of testing activities and submit 2 copies to the General Contractor.

3.7 IDENTIFICATION

- A. Install continuous underground detectable warning tape in accordance with Section 310000 – Earthwork. Locate below finished grade, directly over piping.

3.8 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use;
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet;
 - 3. Use purging and disinfecting procedure prescribed by regulatory authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below; and,
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 24 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination
 - 4. The site utility subcontractor shall prepare reports of purging and disinfecting activities and submit 2 copies to the General Contractor.

END OF SECTION 331416

SECTION 331417 - SITE WATER SERVICE UTILITY LATERALS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings for water service connections.
 - 2. Corporation stop assemblies.
 - 3. Curb stop assemblies.
 - 4. Trenching, bedding, and cover.
- B. All water service connection work shall be performed by, or under the direct supervision of, a licensed Master Plumber in accordance with Section 331416 – Site Water Utility Distribution Piping, Article 1.1D.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 331416 – Site Water Utility Distribution Piping.
 - 2. Section 312316.13 – Trenching.
 - 3. Section 310000 – Earthwork.

1.03 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society of Mechanical Engineers:
 - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. ASTM International:
 - 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 2. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 3. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
 - 4. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
 - 5. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

6. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 7. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 8. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
 9. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- D. American Welding Society:
1. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.
- E. American Water Works Association:
1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 2. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
 3. AWWA C651 - Disinfecting Water Mains
 4. AWWA C800 - Underground Service Line Valves and Fittings.
 5. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
- F. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.04 SUBMITTALS

- A. Only request submittals needed to verify compliance with Project requirements.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statement:
 1. Submit qualifications for manufacturer.
 2. Submit proof of licensed Master Plumber for individual performing or supervising water service connection work.

1.05 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, pressure-pipe centerline elevations, and gravity-pipe invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

- A. Perform Work according to Philadelphia Water Department Standard Specifications and Standard Details (most recent revision), city, state, and federal standards.
- B. Maintain copies of each standard affecting Work of this Section on Site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Installer: All water service connection work shall be performed by, or under the direct supervision of, a licensed Master Plumber licensed in the City of Philadelphia.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.01 WATER PIPING AND FITTINGS

- A. Copper Tubing:
 - 1. Comply with ASTM B88.
 - 2. Type: K annealed.
 - 3. Fittings: Cast copper; ASME B16.18 or wrought copper; ASME B16.22.
 - 4. Joints: Flared or brazed (BCuP silver braze per AWS A5.8) connections required for underground service

2.02 CURB STOP ASSEMBLIES

- A. Manufacturers:
 - 1. Furnish materials according to City of Philadelphia standards.
- B. Curb Stops:
 - 1. Body: Brass or red brass alloy.
 - 2. Type:
 - a. Furnish Roundway curb stops or approved equal, fitted for flared connections on both sides.
 - 3. Comply with ASTM B62.

4. Valve Type: Ball-type.
 5. Sealing: Positive pressure.
- C. Curb Boxes and Covers:
1. Body: Cast iron.
 2. Type:
 - a. Furnish Buffalo type curb boxes or approved equal.
 3. Base: Minneapolis or arch pattern.
 4. Lid:
 - a. Inscription: WATER.
 - b. Plug: Pentagonal.

2.03 MATERIALS

A. Backfill

1. Furnish Sand Backfill for pipe zone in accordance with ASTM C 33 (fine aggregate) and the following:
 - a. Gradation:

Sand Backfill Gradation Requirements:

Sieve No.	200	100	50	16
% Passing	0-5	0-8	5-30	50-98
Sieve No.	4	—	—	—
% Passing	98-100	—	—	—

- b. pH: between 5.5 and 8.5.
 - c. Electrical Resistivity: 10,000 ohm-centimeters, minimum.
 - d. Character: clean, free from lumps of clay or other deleterious substances.
2. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by the Project Manager. The Contractor shall furnish any deficiency of Ordinary Backfill Material.
3. Furnish Select Backfill Material in accordance with the most recent revision or amendment to PennDOT Publication 408 Specifications, Section 703.2, Coarse Aggregate – 2A, or Section 703.3, Select Granular Material-2RC. The use of slag as Select Backfill Material is hereby prohibited.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that building service connections and municipal utility water main sizes, locations, and inverts are as indicated on Drawings.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- B. Remove scale and dirt from inside and outside of piping before assembly.

- C. Prepare pipe connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Bedding:
 - 1. Excavate pipe trench as specified in City of Philadelphia Water Department Water Main Standard Details.
 - 2. Placement:
 - a. Place bedding material as indicated on City of Philadelphia Water Department Water Main Standard Details.
 - b. Level fill materials in one continuous layer not exceeding 6 inches of compacted depth.
 - c. Compact to 95 percent of maximum dry density per ASTM D1557 (Modified Proctor). Compaction standard shall be consistent with Section 310000 – Earthwork, Article 3.2.
 - 3. Backfill around sides and to top of pipe with cover fill, tamp in place, and compact to 95 percent maximum density.
- B. Pipe and Fittings:
 - 1. Installation Standards: Install Work according to Philadelphia Water Department Standard Specifications and Standard Details (most recent revision) and AWWA C600.
- C. Curb Stop Assemblies:
 - 1. Set curb stops on solid bearing.
 - 2. Boxes:
 - a. Center and plumb curb boxes over curb stops.
 - b. Set box cover flush with finished grade.
- D. Disinfection of Water Piping System: In accordance with the most recent amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department and the Standard Specification for Disinfecting Water Mains, W-22 and AWWA C651.

3.04 TOLERANCES

- A. Install pipe to indicated elevation to within tolerance of 5/8 inch.

3.05 FIELD QUALITY CONTROL

- A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Perform pressure test on water distribution system according to City of Philadelphia standards.
- C. Compaction Testing for Bedding: Comply with ASTM D1557.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF DOCUMENT 331417

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SECTION 333100 – SANITARY SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewerage piping.
2. Bedding and cover materials.

B. Related Requirements:

1. Section 310000 - Earthwork.
2. Section 312316.13 - Trenching: Requirements for trenching as required by this Section.
3. Section 330561 - Concrete Manholes: Manholes for sanitary sewerage piping.
4. Section 331416 – Site Water Utility Distribution Piping: PWD permit and coordination requirements.

1.2 DEFINITIONS

- A. Bedding:** Fill placed under, beside, and directly over pipe, prior to subsequent backfill operations.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153 - Ductile-Iron Compact Fittings.
8. AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.

C. ASTM International:

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
4. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
7. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

D. Philadelphia Water Department (PWD):

1. PWD Standard Specifications and Standard Details (most recent revision or amendment).
2. PWD Standard Specification for Disinfecting Water Mains, W-22.

1.4 COORDINATION

- A. Coordinate Work of this Section with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.
- B. The Contractor shall be responsible for obtaining and payment of all sewer connection permit fees associated with this Section. Contractor shall coordinate with Philadelphia Water Department for all required inspections and approvals prior to connection to the municipal sewer system.
- C. Do not interrupt sewer service to occupied facilities unless permitted in writing by the Owner/Engineer. Notify the Engineer and Owner not less than 2 days in advance of any proposed sewer service interruption.

1.5 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer information indicating pipe material to be used and pipe accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statement:
 1. Submit qualifications for manufacturer and installer.
- F. Pre-Construction CCTV Report: Submit pre-construction video inspection report for all existing sanitary sewer pipes within the project limits prior to commencement of construction. See Article 1.12.
- G. Post-Construction CCTV Report: Submit post-construction video inspection report for all sanitary sewer pipes within the project limits, including newly installed and existing pipes, upon completion of construction and prior to final acceptance. See Article 1.12.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record finished locations of pipe runs, connections, manholes, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Perform Work according to Philadelphia Water Department Standard Specifications and Standard Details (most recent revision or amendment) and City of Philadelphia standards.
- B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Store valves in shipping containers with labeling in place.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Block individual and stockpiled pipe lengths to prevent moving.
 - 3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.12 PRE- AND POST-CONSTRUCTION VIDEO INSPECTION (CCTV PIPE SCOPING)

- A. General: The Contractor shall perform closed-circuit television (CCTV) video inspection of sanitary sewer piping within the project limits both before construction commences and after all construction is complete. Inspection shall be performed by a qualified firm experienced in pipeline video inspection. All costs associated with CCTV inspection shall be included in the Contract.
- B. Pre-Construction Scope:
 - 1. Scope all existing sanitary sewer pipes within the project limits, excluding building interior piping, prior to any earth disturbance or construction activity.
 - 2. The purpose of the pre-construction inspection is to document the existing condition of the sanitary system to establish a baseline for comparison at project completion.
 - 3. Pre-construction inspection is not required for sanitary piping that is identified on the Drawings as new construction under this Contract.
- C. Post-Construction Scope:

1. Scope all sanitary sewer pipes within the project limits upon completion of all construction, including all newly installed piping and all existing piping that was retained.
 2. The purpose of the post-construction inspection is to confirm that all piping is undamaged, free of debris and obstruction, and installed to proper line and grade.
- D. Report Requirements: Submit a written CCTV report for both the pre-construction and post-construction inspections. Each report shall include at minimum:
1. Date of inspection.
 2. Pipe identification (location, size, material, direction of flow).
 3. Video recording in digital format (DVD, USB, or approved digital file format).
 4. Written log of observations, including location and description of any defects, debris, infiltration, obstructions, or damage observed, referenced to distance from upstream manhole or cleanout.
 5. Still photographs of significant observations.
 6. Certification by the inspector that the inspection was performed in accordance with NASSCO PACP (Pipeline Assessment Certification Program) standards or approved equivalent.
- E. Submit pre-construction CCTV report to Owner/Authorized Representative prior to commencement of earth disturbance. Submit post-construction CCTV report prior to final acceptance of the Work.
- F. If the pre-construction inspection reveals existing defects or damage, notify Owner/Authorized Representative immediately. The Contractor shall not be responsible for pre-existing conditions documented in the pre-construction report, provided those conditions are clearly identified prior to construction.

PART 2 - PRODUCTS

2.1 SANITARY SEWERAGE PIPING

- A. Ductile-Iron Pipe:
1. Comply with AWWA C151.
 2. Minimum Special Thickness Class: 54 for pipes 12" in diameter and smaller and 56 for pipe larger than 12" in diameter.
 3. End Connections: Bell and spigot.
 4. Outside Coating:
 - a. Type: Asphaltic.
 - b. Minimum Uniform Thickness: 1/8 inch for pipe sizes 3 inches in diameter to 12 inches in diameter, inclusive.
 - c. Comply with AWWA C151.
 5. Lining:
 - a. Type: Cement-mortar lining per AWWA C104.
 - b. Minimum Uniform Thickness: 1/8 inch for pipe sizes 3 inches in diameter to 12 inches in diameter, inclusive.
 - c. Comply with AWWA C104.
 6. PE Encasement: Comply with AWWA C105.
 7. Fittings:

- a. Material: Ductile iron, Class 56 or greater.
- b. Comply with AWWA C153.
- c. Lining: Cement-mortar lined according to AWWA C104.

8. Joints:

- a. Rubber gasket joint devices.
- b. Comply with AWWA C111.

2.2 MANHOLES

- A. As specified in Section 330561 - Concrete Manholes.

2.3 MATERIALS

- A. Bedding and Cover:

- 1. Bedding: Coarse aggregate, Type C or better, in accordance with PennDOT Publication 408, Section 703.2.
- 2. Cover: Coarse aggregate, Type C or better, in accordance with PennDOT Publication 408, Section 703.2.
- 3. Soil Backfill from Above Pipe to Finish Grade:
 - a. On-Site Fill, as specified in Section 310000 - Earthwork.
 - b. Subsoil with no rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.4 MIXES

- A. Grout: As specified in PennDOT Publication 408, Section 1001.2(d).

2.5 ACCESSORIES

- A. Detectable Underground Tape

- 1. Detectable Warning Tape shall be six inches wide (6"), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend ("Caution: Buried Sanitary Sewer Below" or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

2.6 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of pipe.
- B. Certificate of Compliance:

- 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
- 2. Specified shop tests are not required for Work performed by approved manufacturer.

2.7 CCTV INSPECTION EQUIPMENT

- A. CCTV camera equipment shall be capable of producing a clear color video image of the full interior circumference of all pipe diameters to be inspected. Camera shall be self-propelled or

- pulled through the pipe and shall include a footage counter to record distance from the access point.
- B. Inspection shall be conducted in accordance with NASSCO PACP standards or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut is ready to receive Work of this Section.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over-excavation with coarse aggregate.
- B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- C. Protect and support existing sewer lines, utilities, and appurtenances.
- D. Utilities:
 - 1. Maintain profiles of utilities.
 - 2. Coordinate with other utilities to eliminate interference.
 - 3. Notify Architect/Engineer if crossing conflicts occur.

3.3 INSTALLATION

- A. Bedding:
 - 1. Excavate pipe trench as specified in Section 312316.13 - Trenching.
 - 2. Place bedding material at trench bottom.
 - 3. Level materials in continuous layer not exceeding 6 inches.
 - 4. Maintain optimum moisture content of bedding material to attain required compaction density.
- B. Piping:
 - 1. Install pipe, fittings, and accessories according to AWWA C600 and PWD Standard Specifications and Standard Details, and seal joints watertight. Note: Original reference to ASTM D2321 removed — that standard applies to thermoplastic pipe only and is not appropriate for ductile iron sewer pipe.
 - 2. Lay pipe to slope gradients as indicated on Drawings.
 - 3. Begin at downstream end of system and progress upstream.
 - 4. Bedding: Install at sides and over top of pipe, to minimum compacted thickness of 12 inches.
 - 5. Lay bell-and-spigot pipe with bells upstream.
 - 6. Backfill and compact as specified in Section 312316.13 - Trenching.
 - 7. Do not displace or damage pipe when compacting.
 - 8. Connect to building sanitary sewer outlet and municipal sewer system.
 - 9. Pipe Markers:
 - a. Continuous buried 6 inches below finish grade, above piping.
 - b. If multiple pipes occur in common trench, locate tape above centerline of trench.
 - c. Coordinate with trench Work as specified in Section 312316.13 - Trenching.

10. Install Site sanitary sewage system piping to within 5 feet of buildings and connect to building sanitary waste system as specified in Section 221300 - Facility Sanitary Sewerage.

C. Manholes: As specified in Section 330561 - Concrete Manholes.

D. Backfilling:

1. Backfill around sides and to top of pipe with cover fill in minimum lifts of 6 inches.
2. Tamp fill in place and compact to 95 percent of maximum dry density per ASTM D1557 (Modified Proctor), consistent with Section 310000 – Earthwork Article 3.2.
3. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
4. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 TOLERANCES

- A. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

- A. Request inspection by Architect/Engineer and PWD Inspector not less than three (3) days prior to and immediately after placing bedding.

B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
2. Perform testing on Site sanitary sewage system according to PWD Standard Specifications and Standard Details (most recent revision) and local code and City of Philadelphia standards. Testing shall include, at minimum, a low-pressure air test or infiltration/exfiltration test as required by PWD. Test type, procedure, and acceptance criteria shall conform to the applicable PWD Standard Specification for sewer testing.
3. Compaction Testing:
 - a. Comply with ASTM D1557 (Modified Proctor)..

3.6 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
- B. Cap open ends of piping during periods of Work stoppage.

3.7 PRE- AND POST-CONSTRUCTION CCTV PIPE SCOPING

A. Pre-Construction Inspection:

1. Prior to any earth disturbance or construction activity, perform CCTV video inspection of all existing sanitary sewer pipes within the project limits, excluding building interior piping.
2. Flush and clean pipes as necessary to allow clear video inspection. Pipe interiors shall be free of debris, standing water, and obstructions prior to inspection.
3. Submit pre-construction CCTV report to Owner/Authorized Representative for project documentation prior to commencement of earth disturbance. Report shall comply with requirements of Article 1.12D.

4. Phase 1 stormwater pipes recently installed as part of the previous construction phase are excluded from the pre-construction scoping requirement.

B. Post-Construction Inspection:

1. Upon completion of all construction and prior to final acceptance, perform CCTV video inspection of all sanitary sewer pipes within the project limits, including all newly installed piping and all existing piping that was retained.
2. Flush and clean pipes prior to inspection. All pipes shall be free of debris, construction material, and obstructions prior to post-construction inspection.
3. Submit post-construction CCTV report to Owner/Authorized Representative for project documentation. Report shall comply with requirements of Article 1.12D.

- C. If post-construction inspection reveals damage to existing pipes not documented in the pre-construction report, the Contractor shall repair or replace damaged piping at no additional cost to the Owner.

END OF SECTION 333100

SECTION 334009 – CONNECTIONS TO EXISTING STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY OF WORK

- A. The Work described in this Section shall include all materials, labor, equipment and incidentals required to make connections to structures from stormwater conduit piping and sanitary sewer piping as shown on the drawings. All orifice, underdrain, distribution, or other piping that connects to a structure shall have the connection constructed per these Specifications.

1.2 REFERENCES

- A. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 mm Cube Specimens).
- B. ASTM D 638, Test Method for Tensile Properties of Plastics.
- C. ASTM D 695, Test Method for Compressive Properties of Rigid Plastics.
- D. ASTM C 923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
- E. ASTM C 443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- F. Philadelphia Water Department (PWD) Standard Specifications and Standard Details (most recent revision or amendment).

1.3 SUBMITTALS

- A. Before starting this work, submit for approval of Owner/Authorized Representative, manufacturer's literature describing Epoxy Mortar Gel and Epoxy Bonding Agent. Literature must address each requirement (e.g. Compressive Strength per ASTM C109) as specified.
- B. Submit manufacturer's published mix ratio recommendations for Epoxy Mortar to confirm compatibility with the 1:1 ratio specified in Article 2.03A, or identify required adjustments prior to construction.
- C. Submit manufacturer's published minimum cure time data for Epoxy Mortar and Epoxy Bonding Agent under anticipated field temperature conditions.

1.4 PWD CONSTRUCTION CERTIFICATION

- A. Connections to existing stormwater structures are part of the Stormwater Management Practice (SMP) installation and are subject to Philadelphia Water Department Construction Certification

Package (CCP) requirements. The Contractor shall comply with all CCP observation, documentation, and notification requirements as specified in Section 329110, Article 3.3, including notifying the PWD Inspector not less than three (3) days prior to beginning connection work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The following products are acceptable as Epoxy Mortar Gel, provided they continue to meet all requirements:
 - 1. Meta Bond HM Gel, as manufactured by American Meta Seal Company, 509 Washington Avenue, Carlstadt, NJ 07072.
 - 2. Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation, Box 297, Lyndhurst, NJ 07071.
 - 3. Thermal-Chem Mortar Resin Gel (Product No. 304), as manufactured by Thermal-Chem, Inc., 1400 Louis Avenue, Elkgrove, IL 60007.
 - 4. Approved equivalent product.
- B. The following products are acceptable as Epoxy Bonding Agent, provided they continue to meet all requirements.
 - 1. Meta Bond HM, or Meta Bond HM Gel, as manufactured by American Meta Seal Company.
 - 2. Sikastix 370, Sikadur Hi-Mod, or Sikadur 31 Hi-Mod Gel, as manufactured by Sika Corporation.
 - 3. Thermal-Chem Mortar Resin (Product No. 3), or Thermal-Chem Mortar Resin Gel (Product No. 34), as manufactured by Thermal-Chem, Inc.
 - 4. Approved equivalent product.

2.2 MATERIALS

- A. Epoxy Mortar Gel shall:
 - 1. Be a 100% solids formulation.
 - 2. Have a Tensile Strength per ASTM D 638 not less than 3000 psi after 7 days at 73°F.
 - 3. Have a Tensile Elongation per ASTM D 638 not over 7%.

4. Have a Compressive Strength per ASTM D 695 not less than 3000 psi after 24 hours at 73 degrees F, and not less than 6000 psi after 7 days at 73 degrees F.
- B. Sand shall:
1. Be oven-dry silica sand.
 2. Have at least 70% by weight pass #20 sieve.
 3. Have not over 35% by weight pass #40 sieve.
- C. Epoxy Bonding Agent shall meet the requirements for Epoxy Mortar Gel. Note: Confirm that all listed bonding agent products satisfy the strength thresholds specified for Epoxy Mortar Gel in Article 2.02A — manufacturer data sheets should be reviewed at submittal.

2.3 MIXES

- A. Epoxy Mortar shall consist of Epoxy Mortar Gel and Sand mixed at a 1:1 ratio by loose volume, unless the manufacturer's published recommendations require a different ratio, in which case the manufacturer's recommendation shall govern. Confirm mix ratio with submittal per Article 1.03B.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL AND TEMPERATURE REQUIREMENTS

- A. Do not apply epoxy materials when ambient or surface temperature is below 40°F or above 95°F, or when rain or moisture is present on surfaces to be bonded, unless otherwise approved in writing by the manufacturer and Owner/Authorized Representative.
- B. Protect freshly applied epoxy materials from rain, freezing temperatures, and direct sunlight for the full manufacturer-required cure period under actual field temperature conditions.

3.2 MAKING CONNECTION

- A. Make hole(s) in existing structure as necessary to permit connection. Core through existing concrete structures and cut reinforcing as necessary. Remove all dirt, laitance, and other loose or undesirable material from mating surfaces. Check hole(s) for fit.
- B. Prepare mating surfaces by wire brushing, grinding, or other mechanical means to achieve a clean, sound substrate free of oil, grease, curing compounds, and loose material. Blow clean with oil-free compressed air immediately before applying bonding agent.
- C. Comply fully with manufacturers' instructions. Coat mating surfaces with Epoxy Bonding Agent and set pipe. Seal all openings with Epoxy Mortar. Support pipe securely to prevent movement and protect for at least 24 hours.

3.3 INSPECTION AND TESTING

- A. After epoxy has fully cured, inspect all connections visually for voids, cracks, or incomplete sealing. Repair any deficiencies before proceeding with backfill.
- B. Connections to stormwater structures shall be visually inspected by the PWD Inspector as part of the Construction Certification Package (CCP) documentation. Do not backfill connections until inspection is complete and documented.
- C. If directed by the Owner/Authorized Representative or PWD Inspector, perform a leak test on the completed connection prior to backfilling. Test method and acceptance criteria shall be as directed by the Owner/Authorized Representative.

END OF SECTION 334009

SECTION 334200 – STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Section Includes:

1. Stormwater drainage piping.
2. Manholes.
3. Inlets and catch basins.
4. Cleanouts
5. Bedding and cover materials.

B. Related Requirements:

1. Section 310000 – Earthwork.
2. Section 312316.13 – Trenching.
3. Section 330561 – Concrete Manholes
4. Section 334009 – Connections To Existing Structures
5. Section 033053 – Site Cast-in-Place Concrete.
6. Section 329110 – Green Stormwater Infrastructure Soils.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Pipe (4-in to 10-in)
2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe (12-in to 36-in)

B. American Society for Testing and Materials (ASTM)

1. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. A STM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
4. A STM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
5. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Application.
6. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
7. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
8. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
9. ASTM F667/F667M - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

C. American Water Works Association (AWWA)

1. AWWA C150-08 – Thickness Design of Ductile-Iron pipe.
2. AWWA C151-09 – Ductile-Iron Pipe, centrifugally cast.

3. AWWA C111/A21.11-17 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- D. Philadelphia Water Department Quality Certification Standards (QC)
1. QC-2 Standards for Gray/Ductile Iron Castings
 2. QC-13 Standards for Thermoplastic Pipe and Fittings
 3. PWD Standard Specifications and Standard Details (most recent revision or amendment).
- E. Commonwealth of Pennsylvania, Department of Transportation Specifications, Publication 408 (most recent edition).
1. Bulletin 15, General Index of Approved Product Suppliers.
 2. Section 735 – Geotextiles
- F. Where reference is made to one of the above standards the revision in effect at the time of bid opening shall apply.
- 1.3 COORDINATION
- A. Coordinate Work of this Section with termination of storm sewer connection outside building, trenching, connection to foundation drainage system, and municipal sewer utility service.
- 1.4 SUBMITTALS
- A. Product Data: Submit manufacturer information describing pipe, pipe accessories, manholes, inlets, catch basins, headwalls, end sections and cleanouts.
 - B. Submit shop drawings showing details of pipe, fittings, joints and construction methods.
 - C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - D. Manufacturer Instructions: Submit special procedures required to install specified products.
 - E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
 - F. Qualifications Statement:
 1. Submit qualifications for manufacturer
 - G. Pre-Construction CCTV Report: Submit pre-construction video inspection report for all existing stormwater pipes within the project limits prior to commencement of construction. See Article 1.10.
 - H. Post-Construction CCTV Report: Submit post-construction video inspection report for all stormwater pipes within the project limits, including newly installed and existing pipes, upon completion of construction and prior to final acceptance. See Article 1.10.
- 1.5 CLOSEOUT SUBMITTALS
- A. Project Record Documents: Record actual locations of pipe runs, connections, catch basins, inlets, headwalls, end sections, cleanouts, and invert elevations.
 - B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. HDPE pipe shall be furnished by a manufacturer / facility that is certified by the National Transportation Product Evaluation Program (NTPEP). The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.
- B. PP pipe shall be furnished by a manufacturer certified by NTPEP or equivalent certification program, who is fully experienced, reputable, and qualified in the manufacture of PP pipe. The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section.
- C. All pipe, fittings, cleanout covers, domed riser covers, and other products shall be installed to ensure a minimum loading capacity in accordance with H-20 loading, as required by Philadelphia Department of Streets. Any deviation from manufacturer's specifications for product installation (without approval by manufacturer or signed and sealed statement of adequacy by Professional Engineer) is prohibited.
- D. Maintain one (1) copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 PRE- AND POST-CONSTRUCTION VIDEO INSPECTION (CCTV PIPE SCOPING)

- A. General: The Contractor shall perform closed-circuit television (CCTV) video inspection of stormwater drainage piping within the project limits both before construction commences and after all construction is complete. Inspection shall be performed by a qualified firm experienced in pipeline video inspection. All costs associated with CCTV inspection shall be included in the Contract.
- B. Pre-Construction Scope:
 - 1. Scope all existing stormwater pipes within the project limits prior to any earth disturbance or construction activity.

2. The purpose of the pre-construction inspection is to document the existing condition of the stormwater system to establish a baseline for comparison at project completion.
 3. Pre-construction inspection is not required for stormwater piping that was recently installed as part of Phase 1 construction or for piping identified on the Drawings as new construction under this Contract.
- C. Post-Construction Scope:
1. Scope all stormwater pipes within the project limits upon completion of all construction, including all newly installed piping and all existing piping that was retained.
 2. The purpose of the post-construction inspection is to confirm that all piping is undamaged, free of debris and obstruction, and installed to proper line and grade.
- D. Report Requirements: Submit a written CCTV report for both the pre-construction and post-construction inspections. Each report shall include at minimum:
1. Date of inspection.
 2. Pipe identification (location, size, material, direction of flow).
 3. Video recording in digital format (DVD, USB, or approved digital file format).
 4. Written log of observations, including location and description of any defects, debris, infiltration, obstructions, or damage observed, referenced to distance from upstream inlet, manhole, or cleanout.
 5. Still photographs of significant observations.
 6. Certification by the inspector that the inspection was performed in accordance with NASSCO PACP (Pipeline Assessment Certification Program) standards or approved equivalent.
- E. Submit pre-construction CCTV report to Owner/Authorized Representative for project documentation prior to commencement of earth disturbance. Submit post-construction CCTV report prior to final acceptance of the Work.
- F. If the pre-construction inspection reveals existing defects or damage, notify Owner/Authorized Representative immediately. The Contractor shall not be responsible for pre-existing conditions documented in the pre-construction report, provided those conditions are clearly identified prior to construction.

PART 2 - PRODUCTS

2.1 CORRUGATED PE PIPING

- A. Pipe:
1. Comply with ASTM F405.
 - a. Type: Smooth interior.
 - b. Inside Nominal Diameter: As Shown on the Drawings.
- B. Fittings: PE.
- C. Joints: Comply with ASTM F405.

2.2 DUCTILE IRON PIPE

- A. Pipe:

1. Comply with ASTM A746, Class 50.
2. PWD Pre-qualification: Supplier shall be pre-qualified per PWD QC-2 Standards for Gray/Ductile Iron Castings.
3. Type: Service.
4. Inside Nominal Diameter: As Shown on the Drawings.
5. Ends: Bell and spigot.

B. Fittings: Ductile Iron

C. Joints:

1. Comply with ASTM A746.
2. Joint Devices: Rubber gasket.

2.3 REINFORCED CONCRETE PIPING:

A. Pipe: In accordance with PennDOT Publication 408, Section 601.

B. Fittings: Reinforced concrete.

C. Joints:

1. Comply with ASTM C443.
2. Gaskets: Rubber, compression.

2.4 MANHOLES

A. As specified in Section 330561 – Concrete Manholes.

2.5 CATCH BASINS AND INLETS

A. Inlet Box and Top Section:

1. In accordance with PennDOT Publication 408, Section 605.2(d).
2. In accordance with PWD Standard Details for inlets where applicable. Inlet castings shall be furnished by a supplier pre-qualified per PWD QC-2 Standards for Gray/Ductile Iron Castings.

B. Grates and Frames:

1. In accordance with PennDOT Publication 408, Section 605.2(a).
2. Grate and frame castings shall be furnished by a supplier pre-qualified per PWD QC-2 Standards for Gray/Ductile Iron Castings.

2.6 END SECTIONS

A. Flared end section shall be in accordance with PennDOT Publication 408, Section 616.2.

2.7 CLEANOUTS

A. Shaft and Top Section:

1. Material: Same material as horizontal pipe section.
2. Joints: Lipped male/female.

3. Nominal Shaft Diameter: Same as horizontal pipe section, 6 inches maximum.
4. Top Section: Concentric cone.

B. Cleanout Lids and Frames:

1. Materials: Cast iron.
2. Lid:
 - a. Hinged
 - b. Lockable
 - c. Design: Stamped "CLEANOUT"
3. Nominal Lid and Frame Size: 6 inch diameter.

C. Base Pad:

1. Material: Cast-in-Place concrete as specified in Section 033053 – Site Cast-in-Place Concrete.

2.8 AGGREGATE BEDDING

- A. Pipe Zone Bedding and Cover: AASHTO #57 coarse aggregate, clean crushed stone, free of fines, clay, organic material, and frozen material.
- B. Confirm that AASHTO #57 aggregate is consistent with bedding requirements in Section 312316.13 – Trenching and Section 333100 – Sanitary Sewerage Piping. Where a conflict exists, the more stringent requirement shall govern.

2.9 DETECTABLE UNDERGROUND TAPE

- A. Detectable Warning Tape shall be six inches wide (6"), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend ("Caution: Buried Storm Sewer Below" or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

2.10 CCTV INSPECTION EQUIPMENT

- A. CCTV camera equipment shall be capable of producing a clear color video image of the full interior circumference of all pipe diameters to be inspected. Camera shall be self-propelled or pulled through the pipe and shall include a footage counter to record distance from the access point.
- B. Inspection shall be conducted in accordance with NASSCO PACP standards or approved equivalent.

PART 3 - EXECUTION

3.1 CONSTRUCTION CERTIFICATION FORM

- A. The contractor shall fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor shall

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make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.

- B. The CCP shall be completed and signed by one of the following:
 - 1. Professional Engineer
 - 2. Registered Architect
 - 3. Landscape Architect
 - 4. Professional Land Surveyor
 - 5. Professional Geologist
 - 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
 - 1. Geotextile
 - 2. Stone
 - 3. Storage media
 - 4. Piping
 - 5. Soil
 - 6. Other SMP-related devices or appurtenances.

3.2 EXAMINATION

- A. Verify that trench cut is ready to receive Work of this Section.
- B. Verify that excavations, dimensions, and elevations are as indicated on the Drawings.

3.3 PREPARATION

- A. Correct over-excavation with coarse aggregate.
- B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.4 INSTALLATION OF PIPE

- A. Excavate trench to 12 inches below pipe invert, and as specified in Section 312316.13 – Trenching.
- B. Hand trim excavation for accurate placement of piping to indicated elevations.
- C. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than one-sixteenth of an inch (1/16") per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site.
- D. All pipe shall be examined before laying and no piece shall be installed which is found to be defective.
- E. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. HDPE pipe and fittings shall be installed in accordance with ASTM D2321 and the requirements of the manufacturer (see

"Corrugated HDPE Pipe Installation Guide" from ADS), or as otherwise provided herein or on the Drawings.

- F. After the excavation is complete to normal grade of the bottom of the trench and bottom preparation according to the Drawings and Specifications is completed, crushed stone bedding (AASHTO #57 aggregate as specified in Article 2.08A) shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid diameter and hand tools shall be used to force the bedding where needed to give firm continuous support for the pipe. AASHTO #57 aggregate shall then be placed to twelve inches (12") above the top of the pipe.

Compact bedding and aggregate cover to a minimum of 95 percent of maximum dry density per ASTM D1557 (Modified Proctor), consistent with Section 310000 – Earthwork Article 3.2. Detectable underground utility marking tape shall be installed over all pipe not otherwise marked. The initial three feet (3') of backfill above the bedding shall be placed in one-foot (1') layers and carefully compacted. Generally the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three feet (3') of backfill shall be approved by the pipe manufacturer's representative prior to use.

- G. All piping shall be sound and clean before installation. When installation is not in progress for any length of time, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by manufacturer.
- H. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- I. Precautions shall be taken to prevent flotation of the pipe in the trench.
- J. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below the top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, crushed stone shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.
- K. The use of ninety-degree (90°) bend pipe fittings is not permitted in the installation of piping. The Contractor shall use minimum-angle fittings to construct the pipe layout diagrammatically shown in the Drawings. The maximum fitting angle approved for use is forty-five-degrees (45°), and fittings of lesser angles (22½° or 11¼°) are preferred for use where practical.

3.5 BACKFILLING AND COMPACTING PIPES

- A. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by Owner/Authorized Representative.
- B. Place Ordinary Backfill material below three feet (3') from subgrade elevation in all sewer trenches. Place Select Backfill Material-2RC for the top three feet (3') below subgrade elevation. Note: Original article language merged two conflicting requirements. Clarified here as: Ordinary Backfill below 3 feet from subgrade; Select Backfill 2RC for top 3 feet below subgrade.
- C. Compact backfill around and to a depth of six inches (6") over pipes and fittings by hand tamping. Compact all other backfill in eight-inch (8") layers by mechanical tamping. Puddling is prohibited.
- D. When backfill has been placed to three feet (3') below street surface or finish grade, cut off and remove sheathing and shoring (including soldier beams) two feet (2') below street surface or finish grade. All sheathing and shoring shall be removed in its entirety from excavations for infiltration facilities (tree trenches, basins, etc.).

3.6 INSTALLATION OF INLETS AND CATCH BASINS

- A. Install inlet in accordance with PennDOT Publication 408, Section 605.3.
- B. Install inlet in accordance with PWD Standard Details where applicable. Coordinate inlet frame and grate elevations with final pavement grades to ensure proper drainage to inlets.

3.7 TOLERANCES

- A. Maximum Variation from Indicated Pipe Slope: 1/8 inch in 10 feet.

3.8 FIELD QUALITY CONTROL

- A. Request inspection by Engineer and PWD Inspector prior to and immediately after placing aggregate cover over pipe.
- B. If inspection indicates that Work does not meet specified requirements, remove Work and replace at no additional cost to the Owner.

3.9 PIPE TESTING

- A. Upon completion of installation and prior to final acceptance, test stormwater conveyance piping connected to the SMP in accordance with PWD Standard Specifications and Standard Details (most recent revision). Testing shall include, at minimum, one of the following as directed by the Owner/Authorized Representative or PWD Inspector:
 - 1. Low-pressure air test.
 - 2. Mandrel deflection test for flexible pipe.
 - 3. Video (CCTV) inspection.
- B. If test results indicate that Work does not meet acceptance criteria, remove and replace defective pipe and retest at no additional cost to the Owner.

3.10 CLEANING PIPELINES

- A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed prior to approval and acceptance of the pipe by Owner/Authorized Representative.

3.11 PRE- AND POST-CONSTRUCTION CCTV PIPE SCOPING

- A. Pre-Construction Inspection:
 - 1. Prior to any earth disturbance or construction activity, perform CCTV video inspection of all existing stormwater pipes within the project limits.
 - 2. Pre-construction inspection is not required for stormwater piping installed as part of Phase 1 construction or for piping identified on the Drawings as new construction under this Contract.
 - 3. Flush and clean pipes as necessary to allow clear video inspection. Pipe interiors shall be free of debris, standing water, and obstructions prior to inspection.

4. Submit pre-construction CCTV report to Owner/Authorized Representative for project documentation prior to commencement of earth disturbance. Report shall comply with requirements of Article 1.10D.
- B. Post-Construction Inspection:
1. Upon completion of all construction and prior to final acceptance, perform CCTV video inspection of all stormwater pipes within the project limits, including all newly installed piping and all existing piping that was retained.
 2. Flush and clean pipes prior to inspection. All pipes shall be free of debris, construction material, and obstructions prior to post-construction inspection.
 3. Submit post-construction CCTV report to Owner/Authorized Representative for project documentation. Report shall comply with requirements of Article 1.10D.
- C. If post-construction inspection reveals damage to existing pipes not documented in the pre-construction report, the Contractor shall repair or replace damaged piping at no additional cost to the Owner.

END OF SECTION 334200

SECTION 334600 – STORMWATER MANAGEMENT

PART 1 - GENERAL

1.1 SCOPE DESCRIPTION

- A. The work to be done under this section consists of construction activities pertaining to stormwater management, including but not limited to earthwork and excavation; protection of existing features; preparation of subgrade; grading; sheathing and shoring; placement and compaction of clean stone; construction of stone and/or modular stormwater storage structures; installation of geotextiles and impermeable liners where indicated on the Drawings; connection of distribution and drainage piping; backfilling; and any incidental and related operations.
- B. The installation of the Modular storage units shall include any necessary bedding or subgrade preparation not otherwise accounted for, any observation or maintenance ports integral to the modular system, all interfaces required for piping, waterstops, geogrid and geotextile installation, onsite assembly of modular units, and furnishing and installing any additional fittings or appurtenant materials necessary to complete installation of the modular stormwater storage system.

1.2 REFERENCE STANDARDS

- A. The following apply to work in this section:
 - 1. ASTM: Specifications of the American Society for Testing and Materials latest editions. Modifications specified herein shall govern where conflicts with ASTM standards occur.
 - 2. PennDOT: Publication 408 current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications.
 - 3. AASHTO: American Association of State Highway and Transportation Officials, current published standards.
 - 4. PTM: Pennsylvania Test Methods, current published standards.
 - 5. APWA: American Public Works Association, Uniform Color Code.
 - 6. PWD: Philadelphia Water Department Stormwater Management Guidance Manual (latest version), including Chapter 3 (Design Standards) and Chapter 5 (Post-Construction Requirements and Construction Certification Package).
- B. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)
 - 1. Bulletin No. 15: Approved Construction Materials

1.3 SUBMITTALS

- A. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- B. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified requirements. In addition, submit the following:
 - 1. Aggregate:
 - a. Sieve Analysis
 - b. Samples of loose material in sealed bag labeled with the name of the material and manufacturer to be submitted upon request for analysis by the Owner/Authorized Representative. Quantity of sample by weight shall be in accordance with ASTM

standards and may be confirmed by the Philadelphia Water's Bureau of Laboratory Services (BLS) directly at (215) 685-1430.

- c. Report demonstrating that the stone was washed per AASHTO T-11 Standards for less than 0.5% wash loss.
 - 2. Non-woven geotextile: product manufacturer and specification sheets
 - 3. Impermeable liner (if required): product manufacturer and specification sheets
 - 4. Modular stormwater storage units: product manufacturer and specification sheets, installation instructions and maintenance guidelines.
 - 5. Infiltration Testing Report: Submit results of all Double Ring Infiltrometer or Modified Philip-Dunne Permeameter testing required by PWD as part of the Construction Certification Package. Note: Pre-construction infiltration testing has been completed at the basin location. Submit the pre-construction test results with the initial CCP documentation, and submit results of any additional PWD-required construction-phase testing prior to aggregate placement.
- C. Stormwater Storage Modules:
- 1. Provide a single unit, height as specified in the contract drawings to be reviewed and retained by owner.

1.4 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.
- B. Upon completion of relevant excavation work, and prior to placement of geotextile and aggregate, subgrade soil shall be inspected by Owner/Authorized Representative. Survey or acceptable measurement by the Contractor shall verify the finished subgrade elevation in accordance with the construction plans.
- C. Upon completion of placement of subgrade storage (stone fill or as otherwise specified) and geotextile, and prior to backfilling or surface restoration, the structure shall be inspected by Owner/Authorized Representative. Survey or acceptable measurement by the Contractor shall verify the finished elevation(s) of the subsurface stormwater trench in accordance with the construction plans.
- D. Upon completion of placement of surface stormwater features, and prior to backfilling or surface restoration, the structure shall be inspected by Owner/Authorized Representative. Survey or acceptable measurement by the Contractor shall verify the finished elevation(s) of all features in accordance with the construction plans.

1.5 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, and handle all materials to ensure protection from damage.
- B. Bagged materials such as fertilizer, lime, etc. shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer and indication of conformance with state and federal laws, as applicable. Containers shall bear the manufacturer's certificate of compliance covering analysis shall be furnished to Owner/Authorized Representative. Store bagged materials in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.

- C. If stored for an extended period of time, additional measures shall be taken to prevent UV and weather damage
- D. Stored components shall be checked at least once a week. A check of the stored area shall be done to make any minor repairs to the cover or to restack any components that could have fallen over.

PART 2 - PRODUCTS

2.1 AGGREGATE

- A. Coarse aggregates shall meet the following requirements:
 - 1. Maximum wash loss of 0.5% by mass when tested per AASHTO T-11 wash loss test.
 - 2. Minimum Durability Index of 35 (ASTM D3744)
 - 3. Maximum abrasion of 10% for 100 revolutions and maximum of 50% for 500 revolutions
 - 4. All aggregate shall be uniformly graded, clean, and thoroughly washed.
 - 5. Aggregate shall be 100% crushed material.
- B. Unless otherwise approved by PWD, coarse aggregate for the stormwater trenches shall be uniformly graded as defined in Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications (current edition), unless otherwise specified.
 - 1. Grading Requirements for AASHTO No. 57

U.S. Standard Sieve Size	Percent Passing
1½" (37.5 mm)	100
1" (25 mm)	95-100
½" (12.5 mm)	25-60
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5

- 2. Grading Requirements for AASHTO No. 3

U.S. Standard Sieve Size	Percent Passing
2½" (63 mm)	100
2" (50 mm)	90-100
1½" (37.5 mm)	35-70
1" (25 mm)	0-15
½" (12.5 mm)	0-5

- C. Crushed concrete shall not be an acceptable substitute for coarse aggregate.

2.2 SAND

- A. Sand if used or required by the modular manufacture to line the bottom of stormwater trenches shall be AASHTO M-43 No. 9 or 10.
- B. Sand shall not be an acceptable substitute for coarse aggregate

1. Grading Requirements for AASHTO No 9

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 8 (2.36 mm)	10-40
No. 16 (1.18 mm)	0-10
No. 50 (300 µm)	0-5

2. Grading Requirements for AASHTO No 10

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 100 (150 µm)	10-30

2.3 GEOTEXTILES

- A. Non-woven geotextile (drainage filter fabric) consisting of polypropylene fibers
 - 1. Meeting AASHTO Class 1 or Class 2 Geotextile
 - 2. Minimum flow rate: 95 gal/min/ft² (ASTM D-4491)
 - 3. Minimum grab tensile strength: 120 lbs (ASTM D-4632)
 - 4. Minimum Mullen Burst Strength: 225 psi (ASTM D-3786)
 - 5. Minimum puncture strength (2-in flat-end rod): 660 lbs (ASTM D-6241)
 - 6. Minimum Trapezoid Tear Strength: 95 lbs (machine direction) and 75 lbs (cross machine direction) (ASTM D-4533)
 - 7. Minimum UV resistance: 70% retained strength after 500 hrs (ASTM D-4355)
 - 8. Heat-set or heat-calendared fabrics are not permitted.
- B. Geotextiles and geogrids associated with modular stormwater systems shall be as specified by the manufacturer.

2.4 BACKFILL MATERIALS

- A. Ordinary Backfill Material may include all material excavated from the trench and free of objectionable matter, unless rejected by Owner or authorized representative. The Contractor shall furnish any deficiency of Ordinary Backfill Material.
- B. Select Backfill Material shall be furnished where specified in accordance with PennDOT Publication 408 Specifications, Section 703.3, Select Granular Material-2RC (as amended). The use of slag as Select Backfill Material is hereby prohibited.

2.5 WATERSTOPS (ANTI-SEEP COLLARS)

- A. Waterstops (or antiseep collars), if required, shall be quarter-inch ($\frac{1}{4}$ ") HDPE sheets cut to the dimensions indicated and installed per the Drawings. All metal fittings or attachments used shall be nylon or stainless steel (Grade 304 or better). Plastic sealant for weld shall be as suggested by manufacturer.

2.6 DETECTABLE UNDERGROUND TAPE

- A. Detectable Underground Utility Warning Tape shall be six inches wide (6"), 5-mil thickness, with aluminum foil core. Tape shall be printed with an appropriate legend ("Caution: Buried Storm Sewer Below" or as approved) and shall conform to the color standards of the APWA for buried utilities (green for sewer).

2.7 OBSERVATION WELLS

- A. Observation wells shall be four-inch (4") inside diameter rigid Schedule 40 PVC pipe in upper section, with solid cap.
- B. Slotted sections shall be four-inch (4") PVC slotted well with 0.01 slots and attached plug. Atlantic Screen and Manufacturing Item # OE540400 or approved equivalent.
- C. Covers for observation wells shall be lockable ductile iron with gray iron frames, East Jordan Ironworks product #00157024R or approved equivalent. Cover and/or frame shall be stamped "OBS WELL".
- D. Aggregate fill around observation wells shall be consistent with surrounding aggregate.

2.8 MODULAR STORMWATER STORAGE SYSTEMS

- A. Modular Stormwater Storage Systems shall be as indicated on the Drawings. Fittings, installation, and appurtenant materials (geogrids, geotextiles, etc) shall be as specified by the manufacturer.
 - 1. Brentwood Module 20 Series StormTank or Approved equal
- B. The sub-surface stormwater storage system modules require 2.0 ft. cover must withstand, at a minimum live loading consisting of the design truck (HS-20) loading in accordance with AASHTO LRFD Bridge Design Requirements, without geogrid.
- C. The Modular storage units must have a minimum 95% void space.

2.9 STORMWATER SOIL

- A. Refer to Section 329110 – Green Stormwater Infrastructure Soils

2.10 TURF REINFORCEMENT MAT

- A. Temporary Rolled Erosion Control Product (Temporary RECP) meeting PennDOT Publication 408, Section 806.2(a) for Type 2.C or 2.D and meeting the requirements outlined in Table B.
- B. Anchoring Devices meeting PennDOT Publication 408, Section 806.2(c).

PART 3 - EXECUTION

3.1 GENERAL CONDITIONS

- A. Coordinate the installation with the product distributor, to have the distributor on-site during product installation.
- B. Review manufacture's installation procedures and coordinate Sub-surface stormwater storage system installation with other work affected, such as grading, excavation, utilities, construction access, erosion control, etc.
- C. Cold weather installation or assembly of modules should not be undertaken when temperatures are below 40°F, without utilization of a heated facility.
- D. Assembled modules may be walked on, but vehicle traffic is prohibited until properly backfilled and covered per Manufacturer's recommendations. Protect personnel and the installation against damage with highly visible construction tape, fencing or other means until construction is complete.

3.2 CONSTRUCTION CERTIFICATION FORM

- A. The contractor shall fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor shall make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
 - 1. Professional Engineer
 - 2. Registered Architect
 - 3. Landscape Architect
 - 4. Professional Land Surveyor
 - 5. Professional Geologist
 - 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
 - 1. Geotextile
 - 2. Stone
 - 3. Storage media
 - 4. Piping
 - 5. Soil

6. Other SMP-related devices or appurtenances.

3.3 EXCAVATION BELOW GRADE

- A. Subgrade shall be unfrozen, firm, and stable with no standing water, mud, or muck. If the Contractor fails to maintain the subgrade properly, the Contractor shall remove the unsuitable material at no additional cost to owner. If the bottom of any excavation is taken out below the limits shown on the Drawings, it shall be restored at the Contractor's expense with six inch (6") layers of AASHTO #57 aggregate to the elevations shown in the Drawings. Compacted earthen fill is not acceptable.
- B. If in the opinion of owner or authorized representative the undisturbed natural subgrade, at or below the normal grade of the excavation as indicated on the Drawings, is unsuitable for construction, it shall be removed to such depth and width as owner or authorized representative may direct and be replaced with suitable material as directed. These activities shall be included in the appropriate lump sum price bid for the related construction activities by location.
- C. Excavation of trenches required for the installation of all pipes and structures shall be made to the depths and widths indicated on the Drawings. The Contractor shall render the bottom of the excavations firm and dry and in all respects acceptable to owner or authorized representative. Pavement, when encountered, shall be sawcut along straight lines before excavating.
- D. Excavation shall be performed in the dry and shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The existing subgrade shall not be compacted or subject to excessive construction equipment prior to placement of geotextile and crushed stone. If it is essential that equipment be used in the excavated area of infiltration facilities, all equipment must be approved by PWD or authorized representative. Use of equipment with narrow tracks or tires, rubber tires with large lugs, or high pressure tires that will cause excessive compaction shall not be permitted within the excavation. All equipment used within the infiltration basin excavation area shall be logged (type, weight, and tire/track pressure) and the log submitted as part of the CCP documentation.

3.4 EXCAVATION SUPPORT

- A. Furnish, install, monitor and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc) as required by Federal, State or local laws, ordinances, regulations and safety requirements. Support the sides of excavation, to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement or other damage.
- B. The Contractor shall take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with AASHTO #57 aggregate. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete.
- C. All excavation supports shall be carefully removed in such manner so as not to endanger the Work or other adjacent structures, utilities, or property. All voids left or caused by withdrawal of supports shall be immediately filled with crushed stone and compacted. No sheeting shall be left in the trench following installation of improvements.
- D. No payment will be given for sheeting, bracing, etc, during the progress of the work. All payment for installing, maintaining, and removing sheeting and shoring or any other required excavation support shall be included in the appropriate lump sum price bid for the related construction activities by location.

3.5 SUBGRADE PREPARATION AND GRADING

- A. Subgrade of infiltration beds shall be level: Plus or minus one-half inch (+/- ½") over ten feet is acceptable as level.
- B. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of by the Contractor.
- C. In excavation faces, all loose or protruding rocks shall be barred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Drawings or as directed by PWD or authorized representative.
- D. Prior to backfill for stone stormwater systems, Double Ring Infiltrometer Testing or Modified Philip-Dunne Permeameter Testing (as required by PWD) shall be conducted in accordance with ASTM D 3385 or applicable PWD-approved test method. Test frequency and minimum duration shall comply with PWD Construction Certification Package requirements. Test holes shall be located within the limits of the proposed trench excavation and results of the testing shall be submitted to PWD or Owner/Authorized Representative. Note: Pre-construction infiltration testing has been completed at the basin location. Confirm with PWD whether additional construction-phase testing at final subgrade elevation is required prior to aggregate placement.
- E. In locations where subsurface stone storage underlies the stormwater surface feature, all work to prepare the stone storage layer shall be completed prior to installation of surface features. Subsurface stone storage shall be approved by Owner/Authorized Representative prior to installation of surface structures. Appropriate stone foundation shall be utilized in all locations for precast and cast-in-place concrete surrounds and curbing (stone storage may be considered as foundation if compacted stone extends completely under the concrete surrounds).
- F. As-built information of subsurface stone storage and infrastructure below finished grade shall be accurately collected and recorded in accordance with PWD and PADEP requirements prior to backfilling. Cross-reference Section 312200 Article 3.4D for CCP and Record Drawing requirements.

3.6 DISPOSAL OF UNSUITABLE OR SURPLUS MATERIAL

- A. Excavated materials that will not be reused shall be removed from the site of the work and disposed of by the Contractor. Disposal of excavated materials shall be included in the appropriate lump sum price bid for the related construction activities by location, and no additional payment shall be made for disposal of excavated materials regardless of class or condition.
- B. Excavated material shall be stacked without excessive surcharge on the trench bank and without obstructing free access to utilities, private drives and public rights-of-way. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified or shown on the Drawings, and protected.

3.7 BACKFILL

- A. Backfill other than planting soil or aggregate as described elsewhere in the Specifications (such as ordinary or select backfill used to fill over-excavation outside installed structures) shall be brought up evenly on all sides in 8-inch maximum lifts (sand layer shall be placed in a single six-inch (6") lift). Each layer of backfill material shall be compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping. If rolling is employed, it shall be by

use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench. Use a pad foot roller for cohesive fill (silts and clay) and a smooth drum roller or vibrating plate for coarse grained fill (sands and gravels). If material is compacted by hand tamping, there must be at least one laborer tamping for each laborer shoveling material into the trench.

- B. Where pipes are laid in off-street easements, the remainder of the trench (one foot (1') or more above the top of the pipe) shall be filled with common fill in layers not to exceed eight inches (8") and compacted by rolling, tamping or vibrating with mechanical compacting equipment. Wherever a loam or gravel surface exists prior to excavations, it shall be removed, conserved and replaced to the full original depth as part of the work unless specified or shown otherwise. In some areas it may be necessary to remove excess material during the clean up process, so that the ground may be restored to its original level and condition. If the Contractor prefers not to store loam, gravel, or topsoil it shall be replaced with material as specified herein.
- C. Where pipes are laid in PennDOT or local roadways or rights-of-way, the remainder of the trench above the crushed stone backfill and up to the bottom of the specified paving or surface restoration shall be backfilled with fill materials as specified on the Drawings. Lifts shall at no time exceed eight inches (8") loose, and compaction shall be in accordance with these specifications. Preparation and paving shall be performed as shown on the Drawings or as specified herein.

3.8 INSTALLATION OF SUBSURFACE STONE

- A. Impermeable liner, non-woven geotextile, and/or sand layer shall be placed immediately after approval of subgrade preparation (to include infiltration testing). Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked to scarify bottoms of infiltration systems prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to owner.
- B. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least four feet (4') outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.
- C. Install coarse aggregate in eight inch (8") maximum lifts. Lightly compact each layer with equipment, keeping equipment movement on storage bed subgrades to a minimum. Install aggregate to grades indicated on the drawings. Install detectable underground utility warning tape at the perimeter of the subsurface stone storage trench on all sides. Once aggregate is backfilled and compacted to grades indicated on the Drawings, geotextile shall be folded over and overlapped on top of the bed to prevent soil intrusion into the aggregate bed.
- D. Impermeable liner shall be placed in accordance with manufacturer's instructions and as indicated in the Drawings. All seams and openings in the liner shall be sealed according to manufacturer's recommendations and specifications. Adjacent strips of impermeable liner shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater.
- E. Where an existing utility lateral or branch main intersects the stone stormwater storage system, a pass-through conduit (utility sleeve) shall be constructed to convey the existing utility. Owner's Representative shall review and approve any pass-through conduits for utility lines not indicated on the Drawings, and any utility laterals that may be reconstructed such that a pass-through conduit is not necessary shall be so reconstructed.

1. Pass-through conduits shall be constructed of Schedule 40 PVC pipe of adequate diameter to convey the utility lateral within.
2. Waterstops shall be installed at either end of the pass-through conduit, outside the geotextile wrap of the stone stormwater storage.
3. The conduit shall be of watertight construction, and shall be sealed at either end around the existing pipe with non-shrink grout or sealant.
4. Any pass-through conduits for utilities not indicated on the Drawings found to be necessary upon excavation will be paid at a contingency price.
5. The Contractor shall coordinate sleeving of all existing and intersecting utility lines with the owners/operators of said utility lines.
6. Split Pipe Conduit shall be P6F as manufactured by Conduit Repair Systems or approved equal.

3.9 INSTALLATION OF MODULAR SUBSURFACE STORMWATER STORAGE

- A. Installation procedure as follows shall be followed by the Contractor. The Contractor shall also reference the manufacturer's installation guidelines, and where any discrepancy exists owner reserves the right to preempt the manufacturer's installation guidelines as specified herein.
1. Impermeable liner, non-woven geotextile, and/or sand layer shall be placed immediately after approval of subgrade preparation (to include infiltration testing). Subgrades shall not be subject to compaction during excavation or during installation of geotextile and aggregates. Subgrades shall be hand-raked to scarify bottoms prior to geotextile and aggregate placement. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of non-woven geotextile at no extra cost to owner.
 2. Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Geotextile and other liners shall be placed such that seaming shall be minimized. Additional material to be utilized for wrapping above the structure shall be protected from damage until use. Geotextile used shall be in accordance with modular stormwater unit manufacturer's specifications. Adjacent strips of geotextile shall overlap a minimum of eighteen inches (18") or per manufacturer specifications, whichever is greater. Secure non-woven geotextile at least four feet (4') outside of trench and take steps necessary to prevent any runoff or sediment from entering the trench.
 3. After installation of geotextile as specified above, install base layer of minimum six inches (6") of AASHTO #57 stone across footprint of modular structure. Compact stone to 75-80% relative density per ASTM D4253, and level as necessary to produce a consistent surface. Subgrade shall be visually inspected and approved prior to continuing installation.
 4. Utilize a soluble paint to outline the footprint of the modular units to be placed. Care should be taken to note any connections, observation or maintenance ports, or other irregular units to be placed.
 5. Install modules by placing side-by-side, attaching per manufacturer's instructions. Use caution to avoid debris or soil intrusion to the system components.
 6. Attach all pipe connections, observation or maintenance ports, pass-through conduits, or other intrusions to the system. No penetrations other than manufacturer approved ports shall be placed in top or bottom panels of the system. Support pipe in trenches and

during backfill operations to prevent damage. Pipe Connections should extend into the modular system a minimum of 6".

7. Upon completion of the layer course, wrap geotextile or impermeable liner as specified and backfill around the structure with AASHTO #57 to a minimum of twelve inches (12") width. Side backfill shall be laid in maximum twelve-inch (12") depth lifts and compacted to 75-80% relative density per ASTM D4253. Use caution to avoid damage to the geotextile and other components.
8. Repeat steps 5-7 as necessary to complete the full modular stormwater system.
9. Install a twelve inch (12") lift of AASHTO #57 stone over the modular system. Compact to a 75-80% Proctor using vibrating plates or walk-behind non-vibratory rollers (do not use drivable rolling compactors).
10. Complete geotextile or liner wrap of system. Add any port connections to surface, ensuring a proper seal with geotextile or liner wrap.
11. Install detectable underground utility marking tape around perimeter of system to mark the area for future utility detection.
12. Prior to final backfilling and surface restoration, the structure shall be inspected by owner or authorized representative. Survey or acceptable measurement shall verify the finished elevations of the storage structure in accordance with the construction plans.
13. Install remaining cover to a minimum finished cover depth of twenty-four inches (24") as indicated on the plans. Maximum overall depth from surface to invert of system is eleven feet (11'). Complete surface restoration as indicated on the Drawings and as described in Related Work Sections of these specifications.

3.10 INSTALLATION OF ANTISEEP COLLARS (WATERSTOPS)

- A. Antiseep collars shall be installed at transitions between stormwater storage areas and surrounding substances as depicted on the Drawings, or as directed by owner/authorized representative. Geotextile or impermeable liners in place at the interface shall be minimally cut to allow for the pass-through section and then sealed within the solid external sheets of the antiseep collar. All fittings and seals shall be installed to manufacturer's specifications for a watertight seal.
- B. All antiseep collars shall be placed continuously to form a watertight joint. All bends, corners, and splicing shall be made by standard rubber waterstop fittings or by vulcanizing. All collars projecting from the side of the joint shall be protected from damage during construction and be free from defects when the concrete on the adjacent side of the joint is poured in place. All waterstops shall be placed in the center of the joint, with 1/2 of the waterstop on each side of the joint.
- C. All waterstops shall be placed strictly in accordance with the manufacturer's specifications and requirements.

3.11 INSTALLATION OF STORMWATER SOIL

- A. Refer to Section 329110 – Green Stormwater Infrastructure Soils.

3.12 INSTALLATION OF SUBSURFACE BASIN SURFACE FEATURES

- A. All concrete structures shall be placed on stone bedding for stability. In the case where a concrete structure is atop a subsurface stone storage area, this may be considered adequate

bedding. In all other cases, concrete structures shall be placed on a minimum four-inch (4") thick layer of clean AASHTO#57 stone, to extend a minimum of four inches (4") beyond the structure on all sides.

- B. Precast or cast-in-place concrete surrounds shall be installed to the dimensions and elevations indicated on the Drawings. Cast-in-place structures shall be allowed to cure prior to further operations. Connections to inlets, piping, and other associated structures shall be completed prior to backfilling operations. Detailed survey shall confirm installed structure elevations prior to additional work such as backfilling or connection to other systems.
- C. Install all supporting and accessory structures within the stormwater surface feature, such as but not limited to riser structures at specified elevations, splash blocks and velocity dissipators, inlet covers and lay-by inlets, check dams, and wheel stops.

3.13 CLEANING

- A. Perform cleaning during the installation of work and upon completion of the work.
- B. Remove from the site all excess materials, debris, and equipment.

END OF DOCUMENT 334600

SECTION 334616 – STORMWATER CONTROL STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section consists of the construction of the outflow control structures for stormwater management basins.
- B. All materials shall be manufactured, supplied, stored and placed according to the latest referenced standards and as outlined herein.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 334200 – Stormwater Conveyance.
 - 2. Section 334600 – Stormwater Management.
 - 3. Section 330561 – Concrete Manholes.
 - 4. Section 334009 – Connections to Existing Structures.

1.3 SUBMITTALS

- A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.
- B. Certificates of Compliance: Before installation of any Precast Concrete Products, submit an acceptable Certificate of Compliance to Owner/Authorized Representative
- C. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- D. Submit certificates, signed by the materials producer, stating that materials meet or exceed the specified ASTM and ACI requirements
- E. Submit detailed diagrams of all outflow structure depicting dimensions and materials used to construct the entire structure. Indicate knockout elevations and size for all pipe entering manhole structures or other concrete structures.

1.4 QUALITY ASSURANCE

- A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, unless otherwise specified.
- B. All gray and ductile iron castings (grates, frames, manhole covers) shall be furnished by a supplier pre-qualified per Philadelphia Water Department QC-2 Standards for Gray/Ductile Iron Castings.

PART 2 - PRODUCTS

2.1 OUTLET CONTROL STRUCTURE

A. Concrete Inlet Box

- 1. In accordance with PennDOT Publication 408, Section 605.2(d).
- 2. Internal weir wall to meet same design requirements of the inlet side wall. Extend weir wall reinforcement into the inlet box bottom and side walls.
- 3. Minimum concrete compressive strength: 4,000 psi at 28 days, consistent with Section 321600 – Concrete Sidewalks and related concrete specifications. Reinforcing shall comply with ACI 318 and the structural drawings. Weir wall dimensions and reinforcing details shall be as shown on the approved shop drawings.

B. Inlet Grate and Frame

- 1. In accordance with PennDOT Publication 408, Section 605.2(a).
- 2. Casting supplier shall be pre-qualified per PWD QC-2 Standards for Gray/Ductile Iron Castings.

C. Manhole Cover and Frame

- 1. In accordance with PennDOT Publication 408, Section 605.2(b) and applicable PWD Standard Details for manhole covers and frames.
- 2. Casting supplier shall be pre-qualified per PWD QC-2 Standards for Gray/Ductile Iron Castings.

D. Manhole Steps

1. In accordance with PennDOT Publication 408, Section 605.2(c).

E. Precast Top Unit

1. In accordance with PennDOT Publication 408, Section 605.2(b).

F. Inlet Trap/Hood

1. Catch Basin Trap Number R-3711 manufactured by Neenah Foundry Inc. or approved alternative.

G. Flow Control Orifice/Restrictor:

1. The orifice for the outlet control structure shall be formed by coring the weir wall and installing a PVC pipe and cap of the diameter indicated on the Drawings. The PVC pipe and cap shall be Schedule 40 PVC, set flush with or projecting slightly into the upstream face of the weir wall, and sealed watertight at the weir wall penetration with non-shrink grout or hydraulic cement. Diameter and invert elevation shall be as shown on the approved PCSMP drawings.
2. Alternative flow control devices, including a weir plate, orifice plate, or other restrictor, are acceptable subject to approval by the Owner/Authorized Representative, provided the alternative achieves the equivalent orifice diameter and invert elevation shown on the approved PCSMP. Submit product data and installation details for any proposed alternative with the shop drawing submittal required under Article 1.03E.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTLET CONTROL STRUCTURES

- A. Install in accordance with PennDOT Publication 408, Section 605.3.
- B. Install weir wall and all internal components in strict conformance with the approved shop drawings. The Owner/Authorized Representative shall inspect the completed outlet control structure interior — including weir wall, trap/hood, and all pipe connections — prior to any covering, backfilling, or surface restoration. Do not cover the structure until inspection is complete and documented as part of the Construction Certification Package.

3.2 CONSTRUCTION CERTIFICATION FORM

- A. The contractor shall fill out and complete the Philadelphia Water Department SMP Construction Certification Form, as part of the Construction Certification Package (CCP). The contractor shall make, record, and document all measurements, required photos, and provide required documents, reports, and certifications outlined in the CCP.
- B. The CCP shall be completed and signed by one of the following:
 - 1. Professional Engineer
 - 2. Registered Architect
 - 3. Landscape Architect
 - 4. Professional Land Surveyor
 - 5. Professional Geologist
 - 6. Licensed Contractor
- C. The contractor shall contact the project's assigned PWD Inspector at least three (3) days prior to the start of construction of any SMP, including excavation and soil testing, if applicable. The SMP installation must be observed by the PWD inspector.
- D. Provide the PWD Inspector an estimated schedule for placement of any of the following:
 - 1. Geotextile
 - 2. Stone
 - 3. Storage media
 - 4. Piping
 - 5. Soil
 - 6. Other SMP-related devices or appurtenances.

END OF DOCUMENT 334616

SECTION 337119
ELECTRICAL UNDERGROUND DUCTS, DUCTBANKS, AND MANHOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and duct:
 - 1. Rigid polyvinyl chloride (PVC) conduit.
- B. Precast concrete manholes.
- C. Accessories:
 - 1. Underground warning tape.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 012200 - Unit Prices, for additional unit price requirements.
- B. Ductbank:
 - 1. Basis of Measurement: By the lineal foot (meter), for each configuration.
 - 2. Basis of Payment: Includes purchase, delivery, and installation of duct, fittings, supports, and accessories, and for trenching, concrete encasement, and backfill.
- C. Manhole:
 - 1. Basis of Measurement: Per unit.
 - 2. Basis of Payment: Includes purchase, delivery, and installation of manhole.

1.4 REFERENCE STANDARDS

- A. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures; 2019.
- B. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures; 2019.
- C. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures; 2020.
- D. ASTM C1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures; 2016 (Reapproved 2024).

PROJECT 52025E-06-01

MCPHERSON SQUARE LIBRARY RENOVATIONS AND PARK IMPROVEMENTS
ELECTRICAL UNDERGROUND DUCTS, DUCTBANKS, AND MANHOLES

- E. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- F. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- G. NEMA BI 50063 - Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations; 2025.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- J. UL 651A - High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for nonmetallic conduit and manhole accessories.
- C. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes.

1.6 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 and with service facilities within 100 miles (160 km) of Project.

PART 2 PRODUCTS

2.1 CONDUIT AND DUCT

- A. Rigid Polyvinyl Chloride (PVC) Conduit: NFPA 70, Type PVC; comply with NEMA TC 2 and list and label as complying with UL 651; Schedule 40 unless otherwise indicated; rated for use with conductors rated 90 degrees C.
 - 1. Manufacturers:
 - a. Cantex Inc: www.cantexinc.com/#sle.
 - b. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
 - c. JM Eagle: www.jmeagle.com/#sle.

- d. Substitutions: See Section 016000 - Product Requirements.
- 2. Fittings: Comply with NEMA TC 3 and list and label as complying with UL 651.
 - a. Manufacturer: Same as manufacturer of conduit to be connected.

2.2 PRECAST CONCRETE MANHOLES

- A. Manufacturers:
 - 1. Per PECO Utility Co. Standards.
- B. Loading: ASTM C857, Class A-16.
- C. Shape: Square.

2.3 ACCESSORIES

- A. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
 - b. Carlon.
 - c. TrenchSafe.
 - d. IPEX Electrical Inc.
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Underground Warning Tape: Polyethylene tape suitable for direct burial.
 - 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brimar Industries, Inc: www.brimar.com/#sle.
 - c. Seton Identification Products: www.seton.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Legend: Type of service, continuously repeated over full length of tape.
 - 3. Color:

- a. Tape for Buried Power Lines: Black text on red background.

2.4 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Precast Manholes: Inspect in accordance with ASTM C1037.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Verify locations of manholes prior to excavating for installation.
- D. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.

3.2 DUCT BANK INSTALLATION

- A. Install duct with minimum slope of 4 inches per 100 feet (100 mm per 25.4 m) (0.33 percent). Slope duct away from building entrances.
- B. Cut duct square using saw or pipe cutter; de-burr cut ends.
- C. Insert duct to shoulder of fittings; fasten securely.
- D. Install no more than equivalent of three 90-degree bends between pull points.
- E. Provide suitable fittings to accommodate expansion and deflection where required.
- F. Stagger duct joints vertically in concrete encasement 6 inches (150 mm) minimum.
- G. Use suitable separators and chairs installed not greater than 4 feet (1200 mm) on centers.
- H. Band ducts together before backfilling.
- I. Securely anchor duct to prevent movement during concrete placement.
- J. Place concrete under provisions of Section 033000. Use mineral pigment to color concrete red.
- K. Provide minimum 3 inch (75 mm) concrete cover at bottom, top, and sides of ductbank.
- L. Provide two No. 4 steel reinforcing bars in top of bank under paved areas.
- M. Provide suitable pull string in each empty duct except sleeves and nipples.

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MCPHERSON SQUARE LIBRARY RENOVATIONS AND PARK IMPROVEMENTS
ELECTRICAL UNDERGROUND DUCTS, DUCTBANKS, AND MANHOLES

- N. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

3.3 PRE-CAST MANHOLE INSTALLATION

- A. Install and seal precast sections in accordance with ASTM C891.
- B. Install manholes plumb.
- C. Use precast neck and shaft sections to bring manhole cover to finished elevation.

END OF SECTION 337119

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SECTION 337900
SITE GROUNDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrodes, connectors, and conductors.
- B. Grounding wells.
- C. Treatment wells.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 260526 - Grounding and Bonding for Electrical Systems - .
- C. Section 312316 - Excavation: Trenching for grounding.
- D. Section 312316.13 - Trenching: Trenching for grounding.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. IEEE 142 - IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems; 2007, with Errata (2014).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SYSTEM DESCRIPTION

- A. Multiple vertical electrodes buried in a triangular pattern.
- B. Single vertical electrode for local grounding at utility transformer.
- C. Comply with IEEE 142.
- D. Provide grounding systems that provide overall resistance to ground of 5 ohms.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for grounding electrodes and connectors.
- C. Test Reports: Indicate overall resistance to ground at each system.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Nvent.
- B. Erico.
- C. Galvan.
- D. Harger.
- E. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

- A. Rod Electrodes: Copper clad.
 - 1. Diameter: 3/4 inch (19 mm).
 - 2. Length: 10 feet (3 m).
- B. Exothermic Connections:
 - 1. Product: Cadweld, by Nvent ERICO.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- C. Grounding Well Pipe: 8 inch (200 mm) diameter by 24 inch (600 mm) long clay tile pipe with belled end.
- D. Grounding Well Cover: Cast iron with legend "GROUND" embossed on cover.
- E. Treatment Well Liner: 8 inch (200 mm) diameter clay tile perforated pipe.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify completion of filling and backfilling before beginning grounding work.
- B. Verify that trenching is completed before installing horizontal electrodes.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install rod electrodes in vertical position with bottom at least 5 feet (1 600 mm) below frost line.
- C. Provide grounding wells and grounding boxes as indicated.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 014000.
- B. Make final grounding system measurements three or four days after chemical treatment.
- C. Test Procedures: IEEE 142, fall of potential method.

3.4 CLOSEOUT ACTIVITIES

- A. Demonstrate to facility operation and maintenance personnel the location of each accessible grounding connection and each chemical treatment well.

END OF SECTION 337900

APPENDIX

McPherson Square Library

Free Library of Philadelphia

Philadelphia, Pennsylvania



Materials Analysis

January 2026



BUILDING CONSERVATION ASSOCIATES INC.

McPherson Square Library

Free Library of Philadelphia

Philadelphia, Pennsylvania

Materials Analysis

Prepared For

SMP Architects

1600 Walnut Street, 2nd Floor

Philadelphia, PA 19103

Prepared By

Building Conservation Associates, Inc.

242 Cherry St.

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BCA Team

Dorothy S. Krotzer

Wei (Melissa) Luo-Hita

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January 2026



BUILDING CONSERVATION ASSOCIATES INC.

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APPENDICES

Appendix A: Paint Sample Location Key

Appendix B: Paint Sample Stratigraphy Sheets

Appendix C: Stucco Analysis Report (Highbridge Materials Consulting, Inc.)

I.0 INTRODUCTION

At the request of SMP Architects, Building Conservation Associates, Inc. (BCA) performed a range of architectural conservation consulting services for McPherson Square Library, a branch of the Free Library of Philadelphia in the Kensington neighborhood of Philadelphia, Pennsylvania. The library was designed by Philadelphia architectural firm Wilson Eyre & McIlvaine and completed in 1917.

BCA's consulting services were focused on the building's exterior stucco, including the following:

- Performing paint removal tests on the currently painted stucco to determine the most effective methods and products.
- Performing a paint analysis of representative exterior stucco elements to identify the original finishes and make recommendations for repainting.
- Performing an analysis to determine the original stucco composition and make recommendations for a replication stucco mix compatible with the existing materials.
- Performing a visual survey of the stucco to identify conditions requiring repair.

The findings of the above investigations will be used to create a stucco restoration specification and stucco repair drawings as part the construction documents for an ongoing renovation project led by SMP Architects.

The following report summarizes the BCA's findings. The report includes: general background information related to the stucco; BCA's investigation methodology; and a *Summary of Findings* section that discusses the stucco conditions, the most effective paint removal method, and the results of the stucco and paint analyses. The last section of the report includes recommendations for paint removal methods and products, a replication stucco mix, and paint materials and color matches for repainting.

All work required for this study was performed by Dorothy S. Krotzer, Director of BCA South, Wei (Melissa) Luo-Hita, Architectural Conservator, Preston Hull, Senior Conservator, and Kathryn Brown, Senior Conservator. All photographs were taken by BCA in 2025 unless noted otherwise.



Figure 1. McPherson Square Library façade (southeast elevation).



Figure 2. McPherson Square Library, northeast elevation.



Figure 3. McPherson Square Library, northwest elevation.



Figure 4. McPherson Square Library, southwest elevation.

2.0 BACKGROUND INFORMATION

McPherson Square Library is cruciform in plan with a temple-front façade on its southeast elevation and a dome at its center. The building features stuccoed brick masonry walls and columns, a masonry water table, and a terra cotta cornice. The windows are flanked by pilasters and topped with profiled stucco hoods. Other decorative elements include terra cotta column capitals, column bases, string course, and rosettes.

The exterior of the building is largely unaltered from its original construction. Known changes relevant to BCA's scope are noted below.

Relevant Building Chronology

1917	Construction complete and opened to the public. ¹ As discussed later in this report, terra cotta rosettes were likely painted but other terra cotta elements and the stuccoed exterior were likely unpainted (Figure 5).
Pre- late 1950s	Portland cement-based stucco skim coat was likely added to most of the exterior stucco sometime before the late 1950s, based on a historic photograph. The skim coat was painted and the photograph date to late 1950s shows flaking paint, which means the skim coat was in place at the time (Figure 6).
Late 1950s	Earliest photographic evidence of paint on the building's exterior (Figure 6).
Late 1950s–1975	Stucco slope added to the belt course above the water table, presumably to shed water (Figure 7). Previously, the top of the projecting belt course was flat.
1974	Major renovations, including “new facing,” “repairs to the front terrace,” and new aluminum windows and doors. ² The above-mentioned sloped stucco may have been installed during this renovation campaign (Figure 7).
Undated	Brick addition constructed on the rear elevation (northwest).

¹ Historic American Buildings Survey. “Survey Notes - Philadelphia Carnegie Libraries_Historic American Buildings Survey.” Washington, D.C.: Library of Congress, 2006. HABS No. PA-6759. 2.

² Olson, Travis. Rep. *Historic Resource Survey Form McPherson Square Branch Library*. Philadelphia, PA: Philadelphia Parks and Recreation, 2018. 55.



Figure 5. McPherson Square Library in 1917. Image Credit: Rau Art Studios, Inc. Free Library of Philadelphia Digital Collections.



Figure 6. Rear entrance to the library at the northwest elevation, view looking east, late 1950s. Note the flaking paint on the walls. This is the earliest image in which the building is clearly painted. Image Credit: Free Library of Philadelphia Digital Collections.



Figure 7. Image of the renovated library in 1975. This is the earliest image that captures the stucco slope installed above the belt course (arrow). Compare to Figure 6, where the top of the projecting belt course is flat. *Image Credit: Free Library of Philadelphia Digital Collections.*

3.0 METHODOLOGY

3.1 Paint Removal Tests

BCA tested paint removal methods on a representative section of the building's painted stucco walls, including chemical paint strippers and a low-pressure micro-abrasive system. Prior to the paint removal tests, BCA examined the existing paint and coatings in the field and removed two samples in order to perform cross-section analysis to determine the number of layers present. This information helped BCA select the best paint removal methods to test. The initial cross-section analysis found that the stucco consists of a pale yellow original stucco, a brownish gray portland cement skim coat approximately 1/4" thick, and approximately 25 layers of paint and coatings (Figure 29).

Chemical strippers tested include:

- Cathedral Stone Products Light Duty Paint Remover
- Back to Nature Multi-Strip
- Dumond Smart Strip Pro
- Prosoco Saf Strip
- Prosoco Saf Strip 8

Each product was tested on a 10" by 3.5' test panel spanning three different areas of stucco: the belt course, water table, and lower wall. Due to the thick paint build-up, BCA first removed the bulk of the paint layers mechanically by scraping with hand tools, which generally left approximately three to four paint layers of paint on the stucco surface. However, there were some areas where paint was unable to be removed mechanically. BCA brush-applied the paint removers in the test areas and covered them with a thin layer of plastic sheeting to prevent the products from drying. After 90 minutes of dwell time, the paint removers were agitated with a stiff nylon brush and removed with scrapers, followed immediately with pressurized cold-water rinsing at approximately 80 psi.

BCA also tested removal of paint using calcium carbonate micro-abrasive applied with a low pressure blasting system in one small area after the bulk of the paint was removed mechanically. The micro-abrasive was applied using an IBIX portable blasting system.

3.2 Field Microscopy

BCA performed in-situ field microscopy at each location sampled as part of the paint investigation. With the aid of X-ACTO blades and a DermLite field microscope for magnification, BCA made small "craters" approximately 3/8" in diameter to examine the existing paint layer sequencing. Cratering provides the conservator with a general sense of how many finish layers exist, their approximate colors, and the condition of the substrate. Various craters can then be quickly compared to each other to help determine whether an area has been overpainted, repaired and/or restored, whether early finishes may exist, how one area appears in relation to another, and which areas should be sampled for laboratory analysis.

3.3 Laboratory Analysis of Paint Samples

Based on the results of the field microscopy, BCA removed a total of 14 samples from the exterior using X-ACTO blades and an oscillating multi-tool. Substrates sampled include stucco, wood, and terra cotta. Each finish sample was bagged, labeled with its sample number, and returned to BCA's Philadelphia conservation laboratory. The locations of the paint samples are documented in *Appendix A*.

Each sample was embedded in Extec Polyester Clear Resin and sectioned on a Buehler IsoMet low-speed saw. The sectioned samples were then dry polished using a series of fine micro mesh cloths ranging from 4,000 to 12,000 grit. Sectioned samples were observed under a Nikon Eclipse E200 compound microscope in both visible light passed through a daylight correction filter and ultraviolet light. The ultraviolet light was generated by a mercury illumination system filtered through a violet filter cube (V-2A Ex380/420 Dm430 Bar 450M). Photomicrographs of paint samples were taken using Nikon DS-Fi3 color digital camera system and are included in this report to illustrate specific observations. Photomicrographs for all analyzed samples are included in *Appendix B*.

Following identification of target layers through cross-section analysis and bulk sample exposures, BCA performed color matches to finishes of interest. BCA exposed each target layer on the bulk sample and, under magnification and simulated natural light, visually matched the paint to the Munsell color system and the commercial Benjamin Moore color palette.

3.4 Color Names

All color names for paint layers were assigned following the ISCC-NBS Color System. The ISCC-NBS system specifies 267 color categories with non-technical names such as "light yellowish green." The system was developed by the Inter-Society Color Council (ISCC) and the National Bureau of Standards (NBS) in 1955 to provide a standard for specifying colors with common words.³

3.5 Stucco Analysis

BCA identified the original stucco through field investigations and comparison of paint samples containing stucco substrates at different locations. BCA determined that a pale yellow stucco, typically found under a later portland cement skim coat, is likely original. BCA removed a stucco sample on a pilaster and sent it to Highbridge Materials Consulting, Inc. for analysis. Highbridge conducted the stucco analysis in accordance with ASTM Standard C1324-25. Weight percentages of the stucco components (water, carbon dioxide, and aggregate) were measured gravimetrically. Inductively coupled plasma – optical emission spectroscopy (ICP-OES) was used to measure the weight of the oxide. Highbridge's findings are summarized in this report and are the basis for BCA's recommendations for replication stucco. See *Appendix C* for Highbridge's full report.

³ Paul Centore, "sRGB Centroids for the ISCC-NBS Colour System," May 4, 2016, 1.

4.0 SUMMARY OF FINDINGS

4.1 Paint Removal Tests

BCA found that the exterior elements have been painted multiple times. The paint layers at the lower walls are the thickest, totaling approximately 1/8". The paint is detached at many locations, and the detached paint is hard and brittle. BCA's sample analysis shows that there are approximately 25 layers on the lower wall elements.

As discussed in the *Methodology*, BCA tested five chemical paint strippers and one micro-abrasive media on the southwest elevation lower wall and water table. BCA began the test by mechanically removing as much paint as possible, leaving approximately three to four layers of paint on the majority of the test area. However, more paint layers remained in some small sections.

The chemical paint removers tested, testing procedures, and BCA's notes/observations are presented in *Table 1* on the following page. The total dwell time for all test panels was approximately 90 minutes.

Out of the five products tested, Dumond Smart Strip Pro and CSP Light Duty Paint Remover were most effective. Both products removed most of the remaining paint in the test area, with some spots of paint remaining after a 90 minute dwell time. It should be noted that, areas of the building with thicker paint buildup that is unable to be removed by hand, will require longer dwell times.

BCA tested calcium carbonate micro-abrasive media using an IBIX portable blasting system in an area with the bulk of the paint build-up removed. The micro-abrasive was able to remove the remaining paint more thoroughly than the chemical paint removers. However, its application is more labor-intensive than the paint strippers.

Table 1. Summary of paint removal tests. The results are included in the Notes/Observations column. The most effective products with the easiest application process are highlighted in yellow.

Product	Method	Result/Notes
Dumond Smart Strip Pro	Clean surface. Apply a thick, even layer of stripper onto the coating being removed with brush. Cover stripper with plastic sheeting to prevent drying. Remove stripper and paint using scraper and scrubbing with stiff bristle brush. Remove stripper and residue with pressure-water rinse from bottom to top.	Very effective. The product removed about 85% of the paint on the stucco and has good adhesion on vertical surfaces.
Cathedral Stone Products Light Duty Paint Remover	Same method as above.	Very effective. The product removed about 75 to 80% of the paint on the stucco and has good adhesion on vertical surfaces.
Prosoco Safstrip	Same method as above.	Somewhat effective. At least one layer of paint remained on the test area.
Prosoco Safstrip 8	Same method as above.	Somewhat effective and performed slightly better than Safstrip. Removed about 30% of the paint on the stucco.
Back to Nature Multi-strip Advanced	Same method as above.	Minimally effective. Most of the paint still remained on the surface after application.
Calcium Carbonate Micro-abrasive	Apply calcium carbonate media at low pressure using 4mm nozzle at 17 to 25 psi. Rinse with low pressure water.	Very effective. The micro-abrasive was generally able to completely remove the paint. However, the application process is more difficult.



Figure 8. Paint removal test location on the southwest elevation, before testing.



Figure 9. Paint removal test location after mechanical paint removal. Approximately three to four layers of overpaint remained on most of the surface.



Figure 10. Five chemical paint removers were tested on the left side of the pilaster. Each test location measured approximately 10" x 3.5'.



Figure 11. Paint removal test at completion. The CSP Light Duty and Smart Strip Pro performed the best, removing most of the remaining paint layers to reveal the brownish gray stucco skim coat.



Figure 12. A close-up of the top half of the Smart Strip Pro test location, after testing.



Figure 13. A close-up of the bottom half of the Smart Strip Pro test location, after testing.



Figure 14. A close-up of the CSP Light Duty test location, after testing.

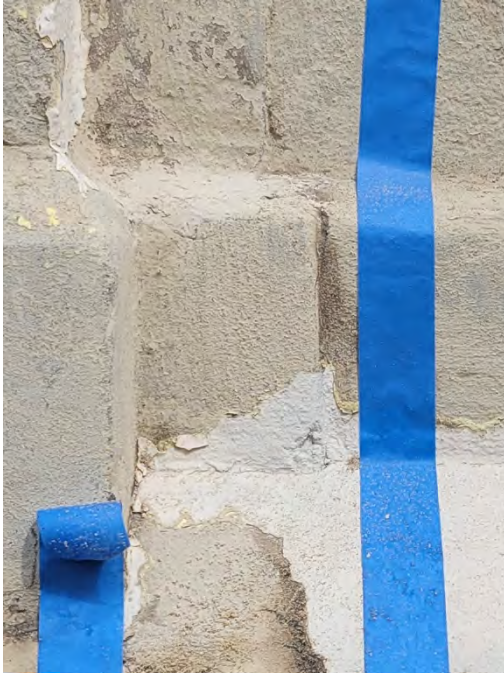


Figure 15. Test location of the calcium carbonate micro-abrasive media, after the most of the overpaint was removed mechanically but before micro-abrasive media was tested.



Figure 16. Test location of the calcium carbonate micro-abrasive media, after testing. Calcium carbonate micro-abrasive media was tested on a small area (circle). It successfully removed the remaining overpaint to reveal the brownish gray stucco skim coat.

4.2 Paint Analysis

BCA performed an exterior paint analysis of painted elements below the terra cotta cornice. No samples were removed from the windows and front doors, as they are not original. The samples removed include:

- MP.1 – Stucco pilaster base
- MP.2 – Not used
- MP.3 – Stucco louvered oval window, keystone
- MP.4 – Stucco pediment field
- MP.5 – Stucco square column capital
- MP.6 – Terra cotta column base
- MP.7 – Stucco arched molding over windows, top molding
- MP.8 – Terra cotta rosette molding
- MP.9 – Terra cotta string course
- MP.10 – Stucco arched molding over windows, fascia
- MP.11 – Stucco arched molding over windows, skyward facing return
- MP.12 – Wood brick mold
- MP.13 – Stucco pilaster capital
- MP.14 – Stucco wall panel, center

Overall, BCA's analysis indicates that the original stucco was unpainted. Most of the terra cotta is glazed in a dark brown or dark olive green color. The glazed terra cotta was also most likely unpainted originally, though the rosettes appear to be a light color in historic photos and they may have been painted. The wood brick mold around the windows has an original glossy dark olive finish, almost an exact match to the dark olive glaze of the terra cotta, suggesting that the exterior wood trim on the building, which appears dark in historic photographs, was likely intended to match the color of the glazed terra cotta.

As mentioned previously in this report, most of the original stucco is coated with a brownish gray portland cement skim coat. None of the samples show any paint or coatings between the original stucco and the skim coat, indicating that the original stucco was exposed and unpainted. The findings are corroborated by the 1917 historic photograph, which shows light colored stucco and dark-to-moderate colored terra cotta string courses, column capitals, and column bases as well as woodwork (Figure 17). Note that the terra cotta rosettes have a light color value, while the ring moldings around them have a dark color value. Unpainted stucco is not unusual for a late 19th-early 20th c. building such as the library. Stucco does not require paint to serve as an effective protective coating for a building, plus the lack of paint would have made for less maintenance overall of the building exterior.

Detailed findings for the paint samples are discussed below by substrate material.

Stucco

As discussed above, BCA's field investigation and sample analysis indicate that the stucco was originally exposed and unpainted (Figure 17). A portland cement skim coat was applied to almost all of the stucco surfaces after it was originally built and there is no paint between the original stucco finish coat and the skim coat (Figure 20–Figure 21). In fact, the surface of the stucco is somewhat soiled and weathered, indicating it was exposed for a period of time. The

paint evidence and historic photographs suggest that paint was first applied sometime between 1925 and 1950. The portland cement skim coat on top has a smoother texture than the original stucco. It is not known whether the portland cement skim coat was left as an unpainted finish or was a preparatory layer for painted finishes. Three layers of light orange yellow, suspected to be oil-based paints based on their yellow autofluorescence in ultraviolet light, were observed on a column shaft sample near the capital (Figure 22). The presence of potential oil-based paint suggests the finishes were applied in the 1940s or earlier, prior to the prevalence of commercial latex paint. The earliest historic photograph that clearly captures painted stucco dates to the late 1950s, at which time the paint was already flaking, suggesting that the paint had been applied for at least a few years (Figure 18).

The earliest existing paint layers on the stucco and the number of paint layers vary by element. However, all are light neutrals or yellows. The lower sections of the building have the greatest number of paint layers, ranging from 15 to 25 layers, likely because they were often painted to cover graffiti (Figure 19).⁴ In contrast, elements higher on the walls, especially profiled elements, have between five to ten layers.

Terra Cotta

BCA removed one sample from a terra cotta feature that included the substrate. The sample, removed from a column base, contains a vitreous glaze that is dark olive (Figure 23). BCA's field investigation found that the terra cotta rosettes (including the field and the ring molding around it), the string course, and the column capitals also feature a dark brown/dark green glaze (Figure 24). These observations suggest that all terra cotta elements originally featured a similar colored glaze, although physical samples would need to be compared side by side to confirm that the color is similar. Glazed terra cotta would typically not have been painted. However, the rosettes appears to have a contrasting, light color value in the 1917 photograph, suggesting a portion of these decorative elements may have been painted. The earliest existing finish on the rosette sample is a greenish yellow gray; however, this paint layer appears to be a modern latex paint. It is likely that the original painted finish was lost in the locations investigated by BCA (Figure 25).

Wood

The only accessible historic wood element was the brick mold around the windows. The sample contains approximately 20 layers, an indication that it is likely an original element. The original finish on the brick mold is a glossy dark olive finish, achieved by applying a glossy pigmented coating (varnish) over a grayish olive green base layer (Figure 26). The overall color is a close approximation to the original terra cotta glaze, suggesting they were intended to match. After the original finish, the brick mold was painted in a series of light orange yellows, followed by a few dark blues, then painted in light neutrals.

⁴ Representatives from the City of Philadelphia report that paint coatings are routinely applied at McPherson Square Library to cover graffiti.

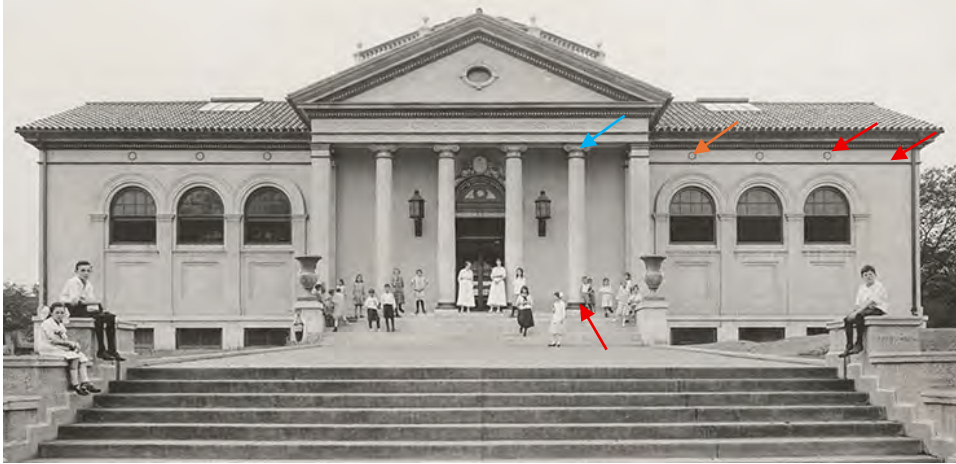


Figure 17. The photograph dated to 1917 likely captured the building's original finish. The stucco is light colored, likely unpainted. The terra cotta elements were glazed in one or more tones. The column bases, string course, and the ring molding around the rosettes appear dark, likely representing the dark olive glaze (red arrows). The column capitals that appear lighter likely had a different glaze (blue arrow). The rosettes have a dark glaze but appear in a light color value, likely painted (orange arrow). *Image Credit: Rau Art Studios, Inc. Free Library of Philadelphia Digital Collections.*

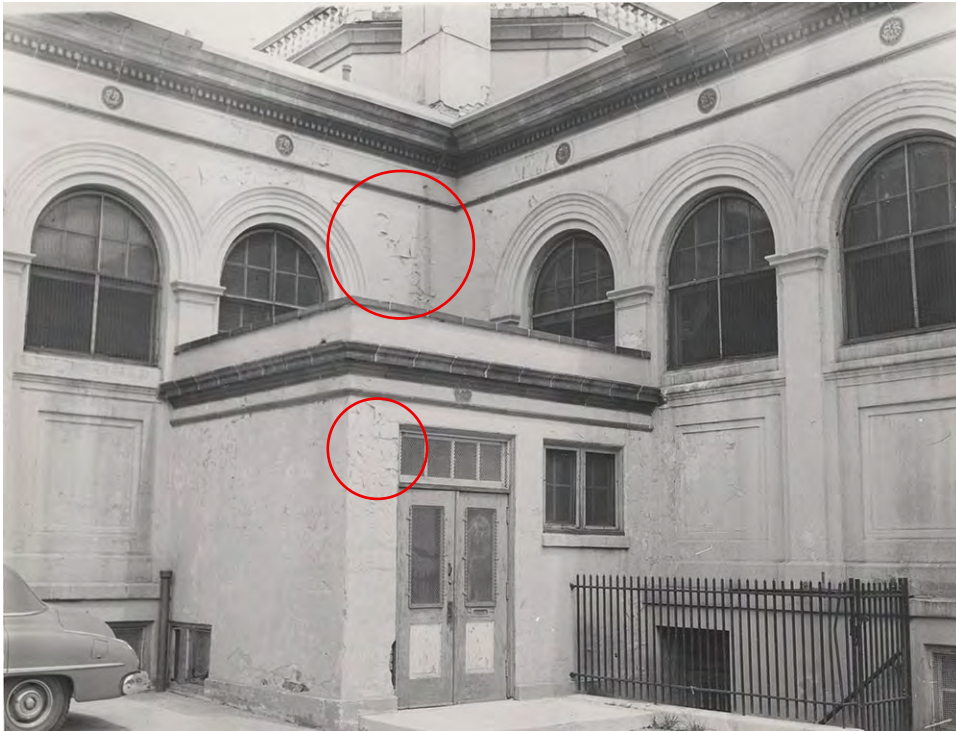


Figure 18. The late 1950s image shows that the paint on the building was already failing, with visible areas of flaking (circles). *Image Credit: Free Library of Philadelphia Digital Collections.*

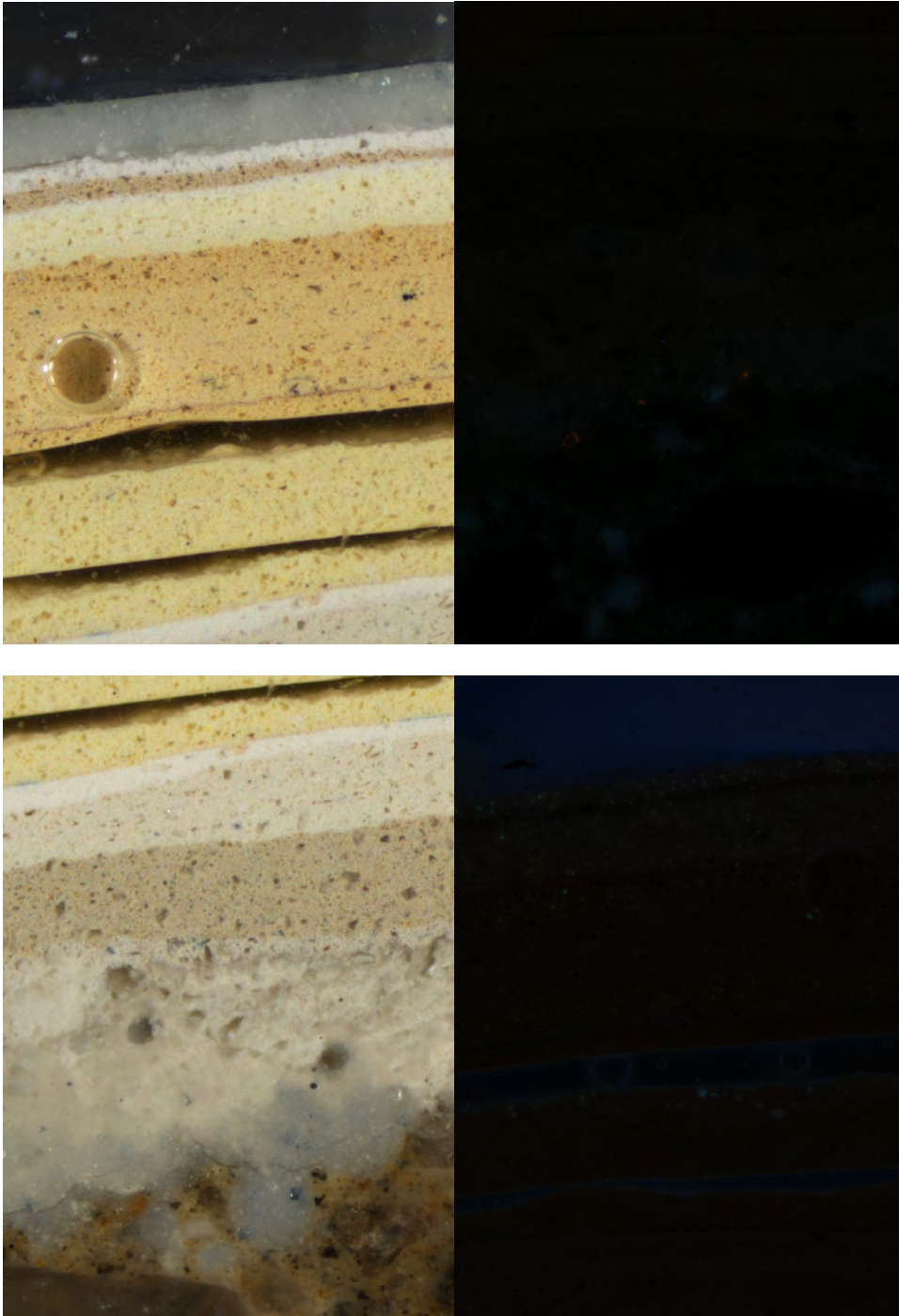


Figure 19. Cross section of a typical sample removed from the lower wall panel. The number of layers on the stucco varies among the samples. The lower walls were painted more often to cover graffiti. This location has approximately 15 layers, all of which appear to be latex paint from the lack of autofluorescence in ultraviolet light. *MP. 14, visible light (L), ultraviolet light (R), 40x magnification.*

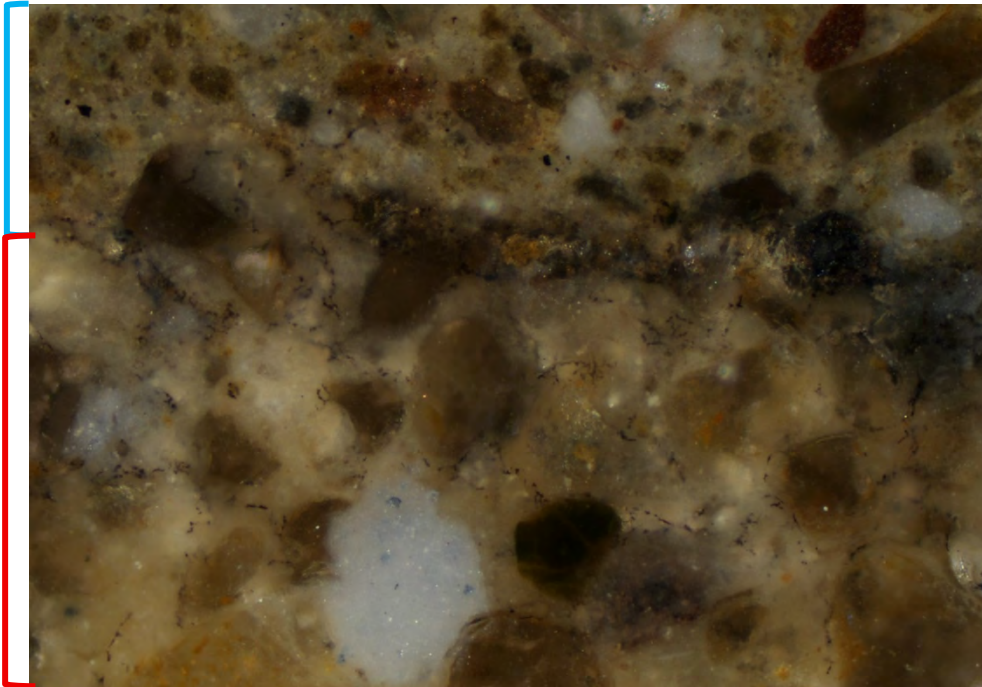


Figure 20. This cross section of an arched molding sample captures the portland cement skim coat (blue bracket) on top of the original stucco finish coat (red bracket). There is no paint between the two coats. *MP.10, visible light, 40x magnification.*

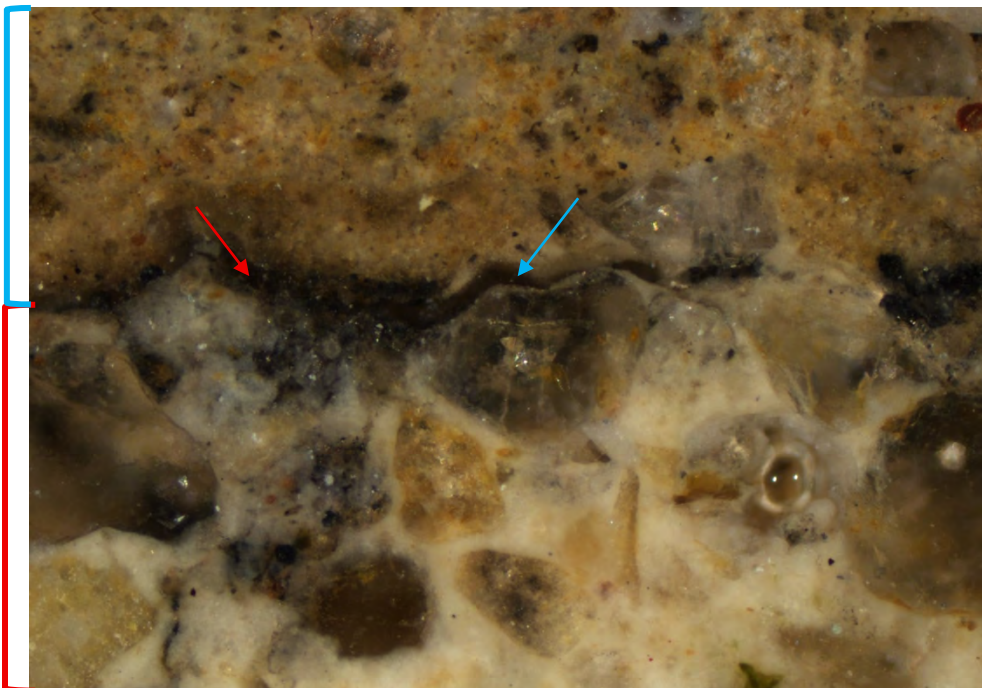


Figure 21. A cross section of a pilaster base sample showing no paint between the portland cement skim coat (blue bracket) and the original stucco finish coat (red bracket). However, there is evidence of soiling (red arrow) and a separation (blue arrow) between the two layers. *MP.1, visible light, 40x magnification.*

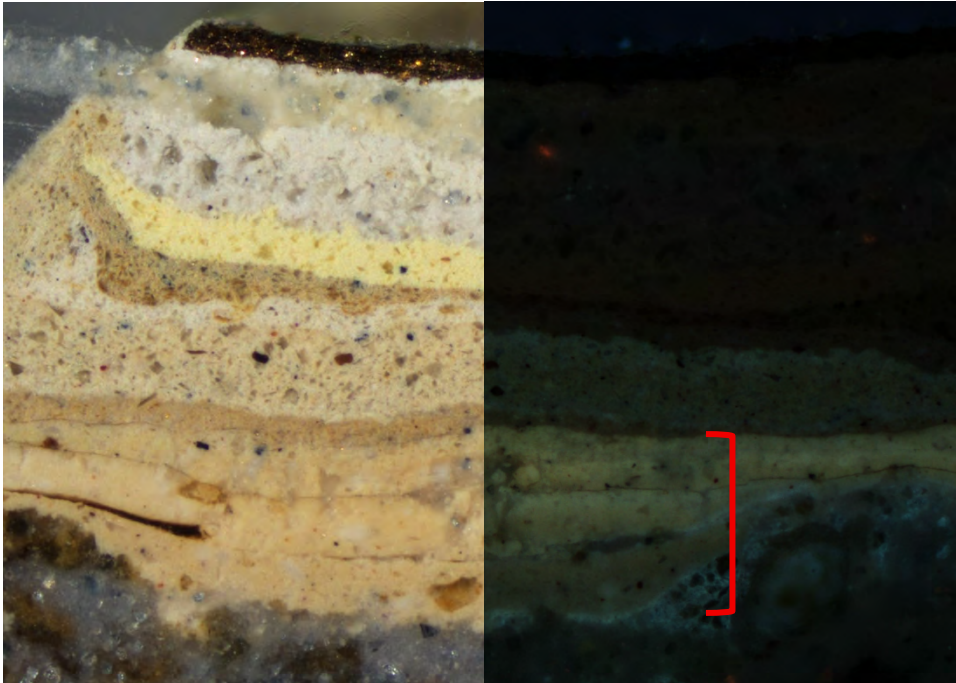


Figure 22. The stucco column shaft directly below the capital is the only sample that appears to contain a suspected oil-based paint, indicated by the layers' yellow autofluorescence in ultraviolet light (brackets). Oil-based paints were common before they were replaced by commercial latex paint after the 1940s, suggesting that these layers are early. MP.5, visible light (L), ultraviolet light (R), 40x magnification.

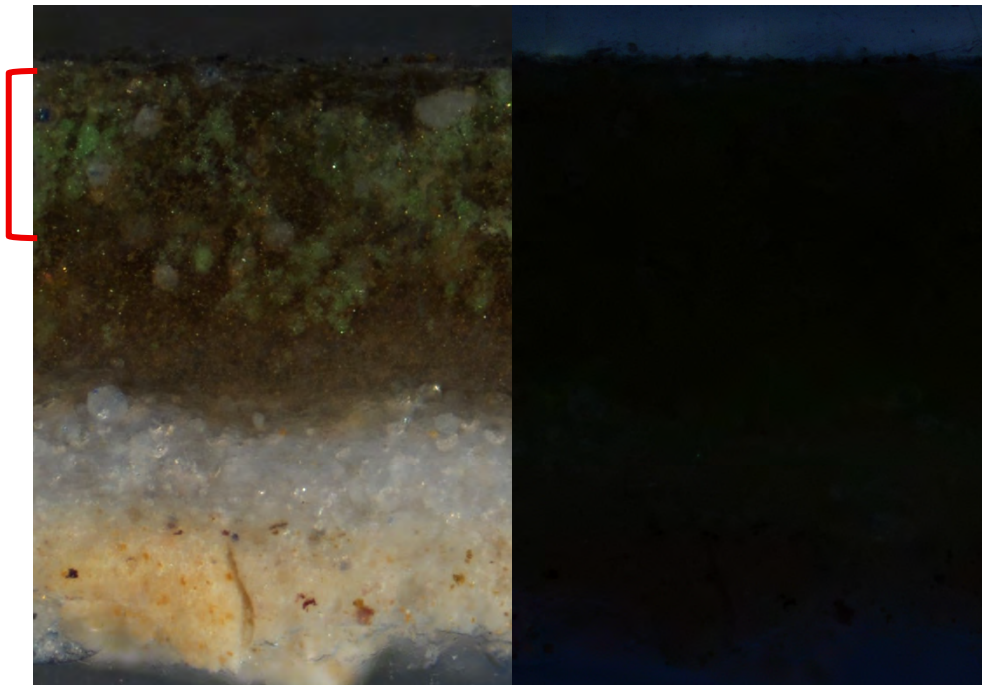


Figure 23. The original glaze on the terra cotta column base is a dark olive (bracket). The paint layers are not captured in this cross-section. MP.6, visible light (L), ultraviolet light (R), 40x magnification.



Figure 24. Field investigation was performed on the terra cotta rosette and surrounding moldings by scraping away to overpaint to observe the substrate and number of paint layers present. All terra cotta elements appear to have a dark brown or dark green glaze (arrows).

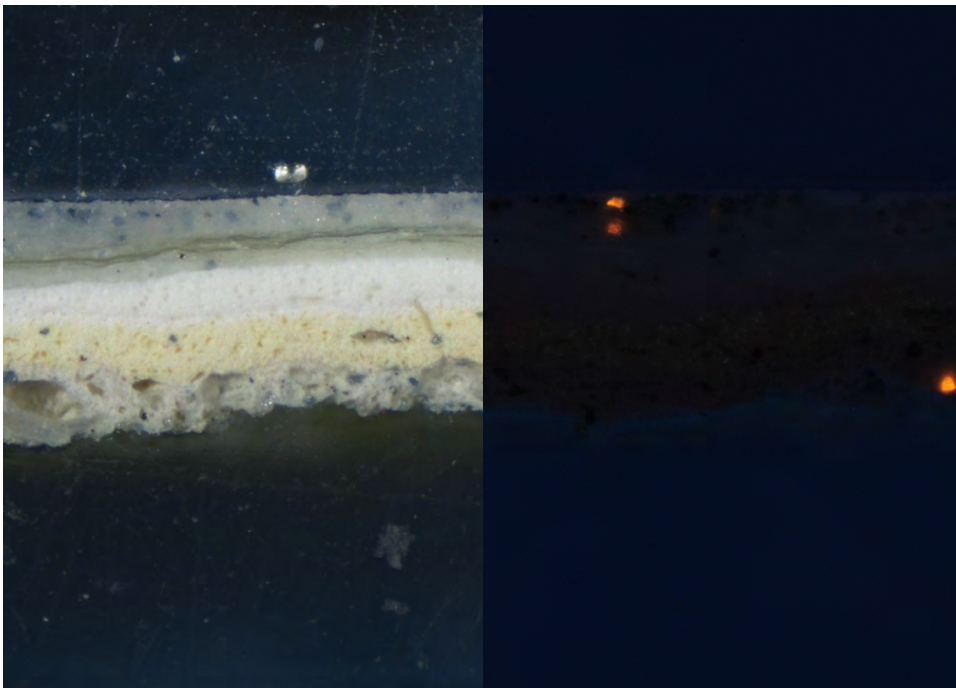


Figure 25. The sample removed from the ring molding around the rosette (not including terra cotta substrate) has only been painted a few times in latex paint. Field investigation found that the molding has a dark brown or dark olive glaze. Based on the historic photograph, this element still appeared in a dark color value, likely unpainted, in 1975 (see Figure 7). MP.8, visible light (L), ultraviolet light (R), 40x magnification.

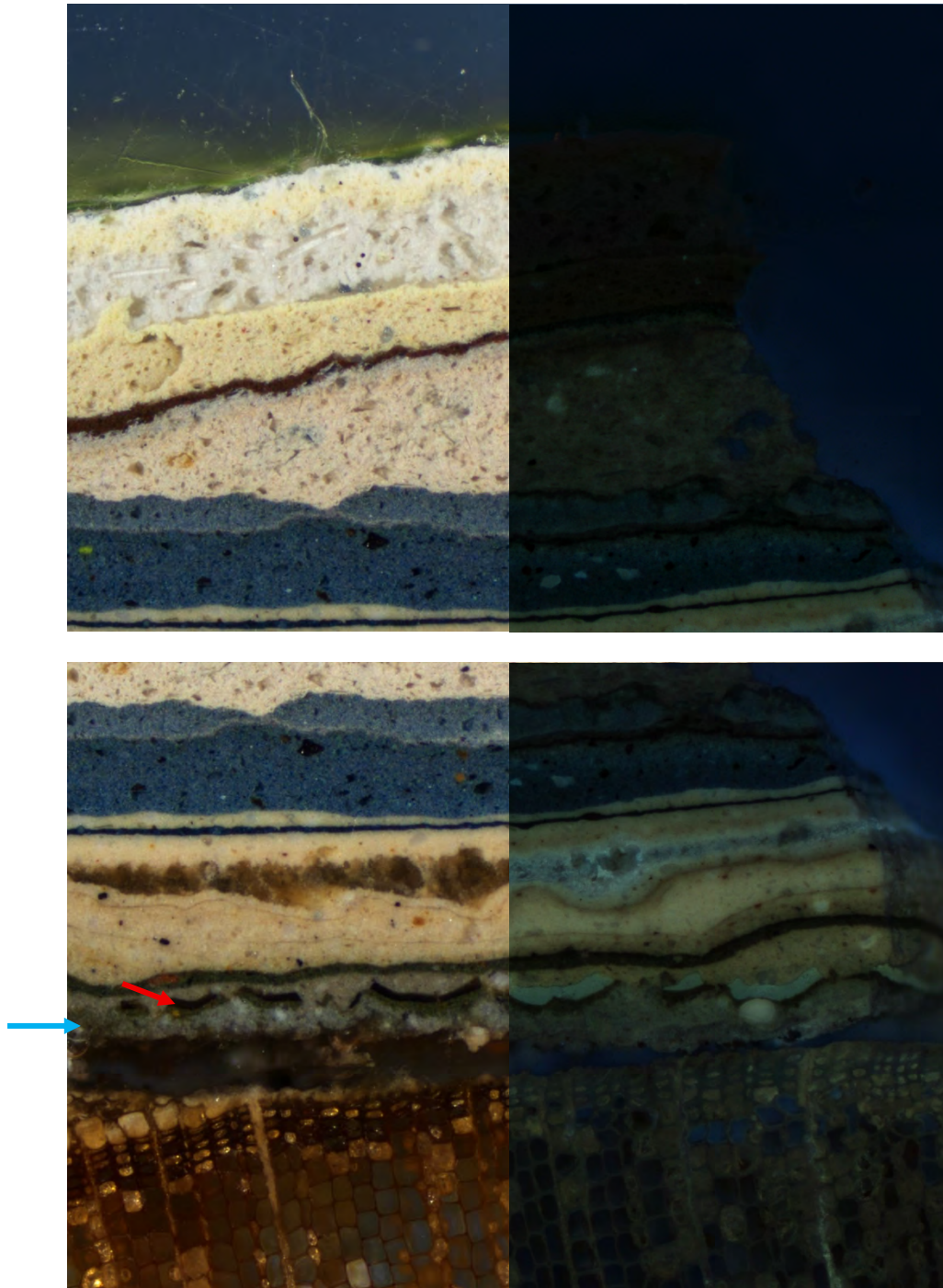


Figure 26. The brick mold has been painted many times, suggesting it is likely an original element. The original finish is a glossy dark olive finish consisting of a grayish olive green base layer (blue arrow) topped with a dark olive coating or glaze (red arrow). MP.12, visible light (L), ultraviolet light (R), 40x magnification.

4.3 Stucco Analysis

BCA performed a stucco conditions assessment that was documented in a memo dated September 8, 2025. BCA determined that the pale yellow stucco layer directly under the brownish gray portland cement skim coat, which is present on most of the building, is the original stucco. BCA removed one sample of the original stucco from a pilaster. The sample has four distinctive layers, from bottom to top: original scratch coat; original brown coat; original finish coat; and the later portland cement skim coat (Figure 27–Figure 29). There are two clear fissures between the original stucco coats, which may be due to the original installation of the stucco in different lifts or it could be due to differential movement of the various materials on the stucco (the original stucco, the portland cement skim coat and the thick paint build-up).

The stucco analysis focused on the original finish coat, and not the scratch or brown coats. The lower stucco layers would have most likely been composed of the same materials, but possibly using slightly different proportions. The results show that the original stucco finish coat contains white portland cement, dolomitic lime, and sand. The lime was added as slaked putty; the sand is yellowish brown, somewhat fine-grained, and broadly graded. The sand contains glauconite, which appears as black flecks. The cement to lime ratio is between 1 : 2.3 and 1 : 3.2 by volume with lime as a dry hydrate. The binder to sand ratio is between 1 : 2.3 to 1 : 3.0 by volume with lime as a dry hydrate. The quantity of lime in the finish coat exceeds that recommended by modern standards for stucco. The high lime content created a stucco coat that is moderately soft with a relatively high permeability. While there are no obvious deficiencies in the stucco material, there is evidence of microcracking and secondary gypsum deposition.



Figure 27. An existing area of deterioration where the portland cement skim coat has detached, exposing the original pale yellow finish coat.



Figure 28. The stucco sample was removed from a pilaster on the southwest elevation.

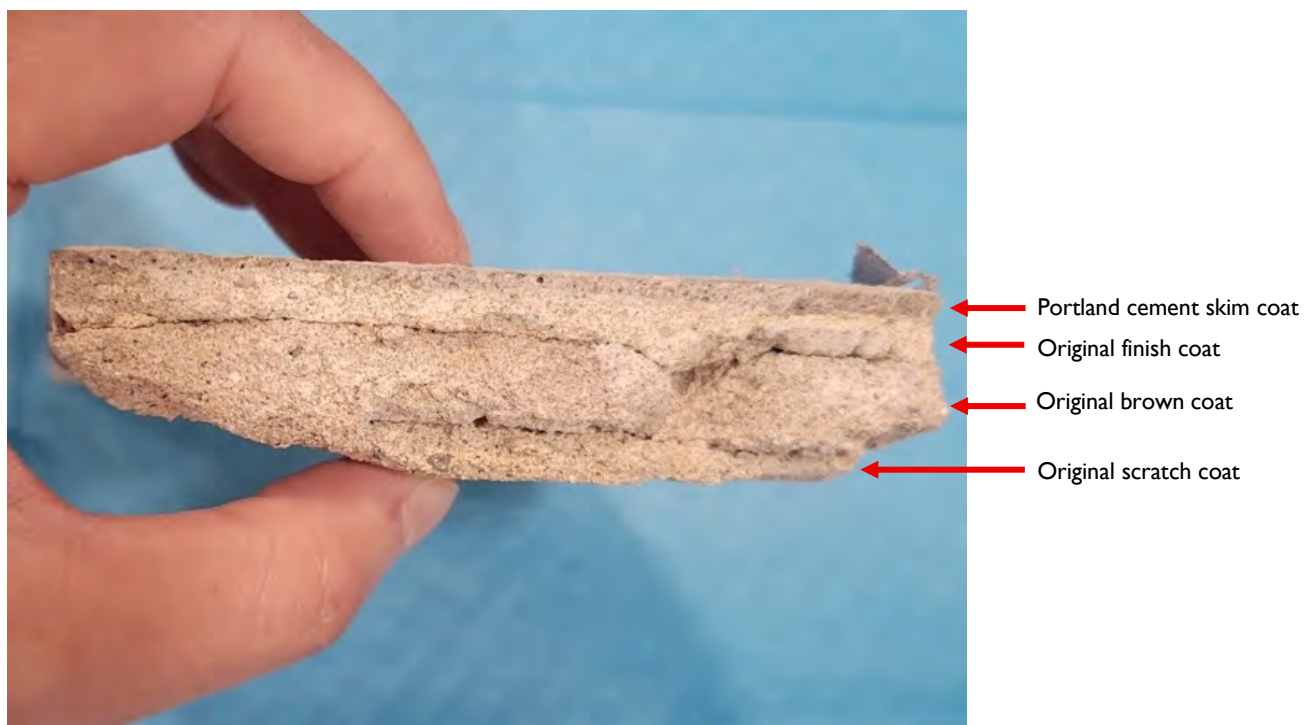


Figure 29. A section of the stucco sample with each layer labeled on the right.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Paint Removal Tests

BCA's paint removal tests determined that the most successful and practical method for removing the existing paint includes first removing the bulk of the paint buildup mechanically with hand tools, followed by application of a chemical paint remover. Micro-abrasive techniques were successful in removing even more paint than the strippers, but were felt to be unnecessary given the level of preparation required for repainting the stucco. The most effective paint removers tested were Cathedral Stone Products Light Duty Paint Remover and Dumond Smart Strip Pro.

Paint Analysis

The original exterior finish scheme for the library consisted of pale yellow, unpainted stucco elements, glazed dark olive green-dark brown terra cotta elements (except rosettes) and glossy dark olive green exterior woodwork most likely intended to match the terra cotta (based on paint evidence found on a brick mold). The terra cotta rosettes were painted in a light color, although physical evidence of this layer was not found, it was likely a similar color as the unpainted stucco based on the 1917 historic photograph. Paint color matches to the original finishes are found on the following page.

Stucco Analysis

The original stucco finish coat consists of white portland cement, dolomitic lime, and natural sand. The portland cement to lime ratio is between 1 : 2.3 and 1 : 3.2 by volume, and the binder to sand ratio is between 1 : 2.3 and 1 : 3 by volume. The composition of the finish coat is too lime-rich to meet modern stucco standards, therefore, an alternative stucco mix that is compatible with existing materials and conforms to modern standards is recommended below.

5.2 Recommendations

Paint Removal

BCA recommends removing all of the flaking and failed paint from the stucco elements to create a stable substrate for painting. This paint removal can be achieved through a combination of hand scraping and chemical strippers (Cathedral Stone Products Light Duty Paint Remover and Dumond Smart Strip Pro). Because conditions around the building vary, BCA recommends having the contractor perform larger tests and mockups of this technique in multiple locations during construction. The goal of the testing will be to determine the best method and dwell times at each architectural feature and substrate to account for varying conditions across the building.

Although BCA did not perform paint removal tests on the terra cotta, it is still recommended to remove 100% of the paint and coatings from all terra cotta elements to expose their original vitreous glazed finish. In addition, if the existing brick molds are retained as part of the

renovation, BCA recommends removal of 100% of existing coatings for optimal adhesion and durability.

Painting

Because removal of the portland cement skim coat and exposure of the original stucco is not possible, BCA recommends removing as much of the loose and failing paint as possible and repainting the existing, skim coated stucco to simulate the appearance of the original unpainted stucco.

After repairs are completed, BCA recommends that the stucco elements be painted with a mineral-based paint system in a color matching the original unpainted stucco. The recommended paint system is indicated below:

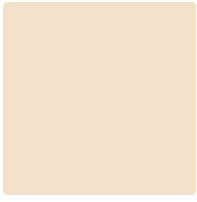
1. Primer (Coat 1): KEIM Soldalit Grob or Contact Plus Grob, as determined by testing and mockups.
2. Finish Coats (Coats 2 and 3): KEIM Soldalit Sol-Silicate All Surface Mineral Finish.

Because the painted finish of the terra cotta rosettes is unknown, BCA recommends painting the rosettes in the same color as the stucco. The outer ring and other terra cotta elements should remain unpainted after they have been stripped of paint and the original glaze repaired as needed. The recommended color match for the original brick mold finish is also provided below.

The color matches for original finishes are provided in the table below. Note that the stucco color match is approximate because the stucco contains sand, which affects the overall color. The color match for the original brick mold finish is also approximate because the original finish is a translucent glossy coating and must be color matched in situ to accurately replicate the finish and sheen.

The element where each color was documented is listed in the left column. The color name and color matches to the standardized Munsell color system and the commercial Benjamin Moore color palette are presented in the middle column. A virtual rendition of the Benjamin Moore color swatch is included in the right column. The color swatches in this report are for reference only. Due to differences in monitors and printers, only physical swatches of the stated Munsell notation or Benjamin Moore color system should be used for paint replication purposes.

Table 2. Color Match for Exterior Elements at McPherson Square Library.

Element(s)	Color Match	B. Moore Swatch
All stucco elements	<i>Finish: pale yellow</i> <i>Approximate Munsell Color Match: 2.5Y 8/2</i> <i>Approximate Benjamin Moore Color Match: OC-84 Creme Caramel</i>	
Terra cotta rosettes	<i>Finish: pale yellow</i> <i>Munsell Color Match: 2.5Y 8/2</i> <i>Benjamin Moore Color Match: OC-84 Creme Caramel</i>	
Wood brick mold	<i>Finish: glossy dark olive</i> <i>Approximate Munsell Color Match: 10Y 2/2</i> <i>Approximate Benjamin Moore Color Match: 2140-10 Fatigue Green</i>	

Replication Stucco

BCA is recommending the following stucco mixes to be used for repairs, all of which conform to ASTM C926-22c *Standard Specification for Application of Portland Cement-Based Plaster*. The recommended mixes are intended to be compatible with both the original stucco coats and the later portland cement skim coat. The color and texture of the finish coat of the replication stucco should be at least a close match to the existing portland cement skim coat to minimize any potential contrasting appearance when the stucco is painted.

Replication Stucco Mix Recommendations

First Coat (Scratch Coat)

- 1 part white portland cement
- 1 part hydrated lime
- 5 to 8 parts sand with reinforcement fibers at manufacture's recommended quantity

Second Coat (Brown Coat)

- 1 part white portland cement
- 1 part hydrated lime
- 6 to 10 parts sand. Second coat to have the same or greater aggregate proportion than the first coat per ASTM C926.

Finish Coat

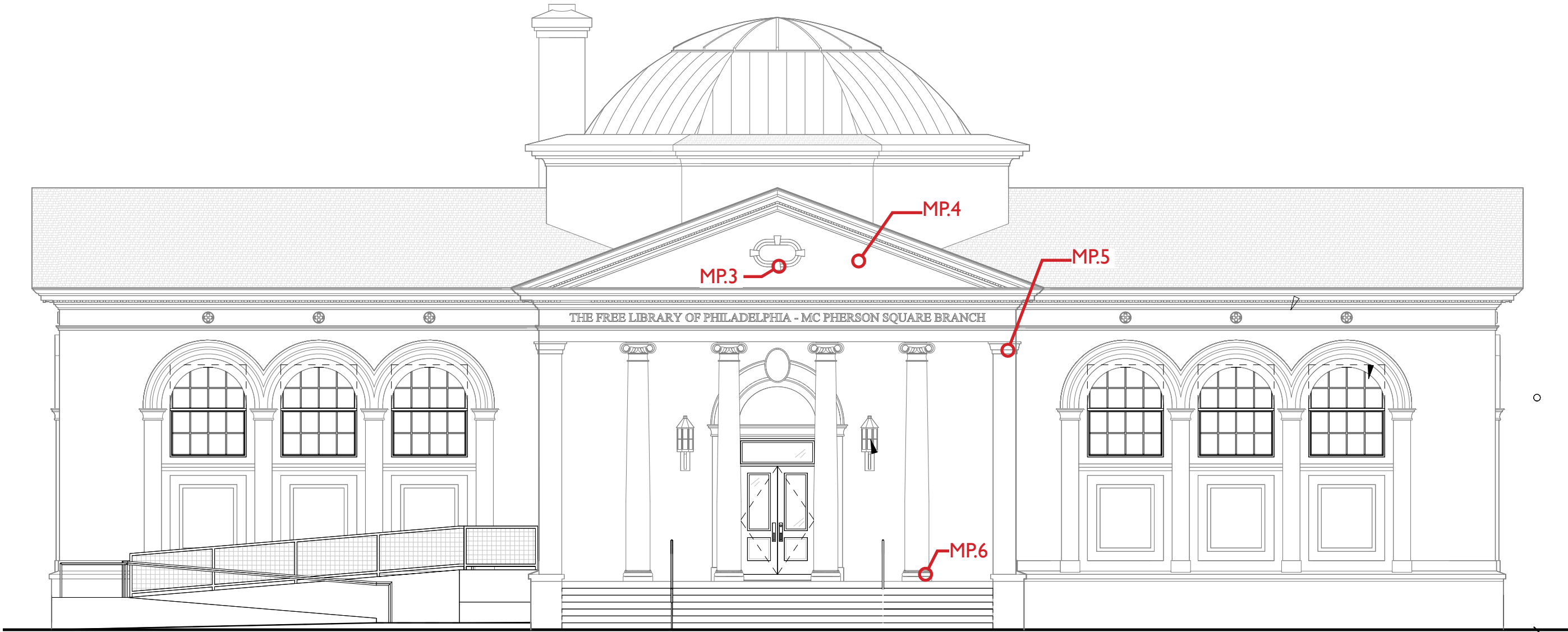
- 1 part white, gray, or blended portland cement to match color of existing skim coat
- 1 part hydrated lime
- 3 to 4 parts sand.

Finish coat color: achieve color by blending white and gray portland cement and using appropriately colored aggregate.

Finish coat texture: finish replication stucco to match the texture of existing portland cement skim coat.

APPENDIX A
PAINT SAMPLE LOCATION KEY

McPherson Square Library Paint Sample Location Key
Samples Collected by Building Conservation Associates, Inc. on Septebmer 16, 2025



Southeast Elevation

Key

MP.## (McPherson.Sample #) Paint Sample Number

McPherson Square Library Paint Sample Location Key
Samples Collected by Building Conservation Associates, Inc. on Septebmer 16, 2025

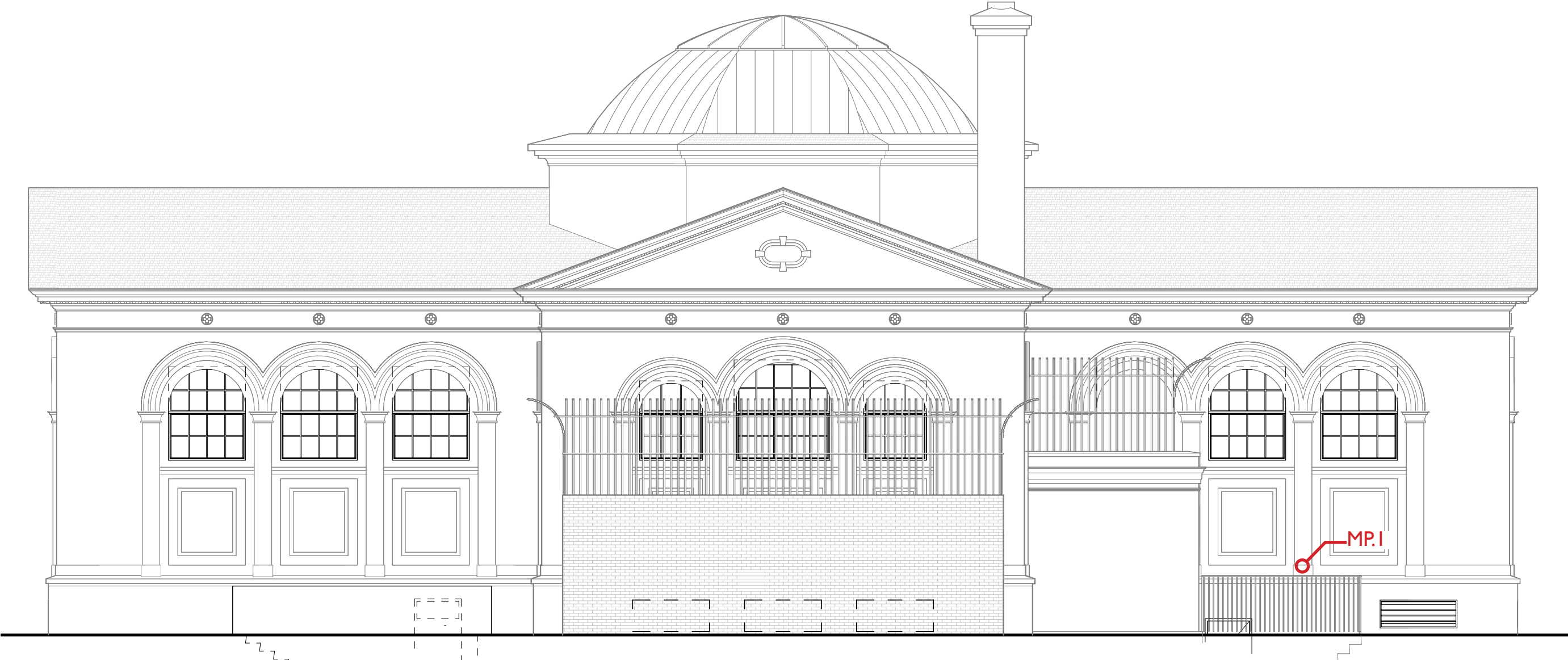


Northeast Elevation

Key

MP.## (McPherson.Sample #) Paint Sample Number

McPherson Square Library Paint Sample Location Key
Samples Collected by Building Conservation Associates, Inc. on September 16, 2025



Northwest Elevation

Key

MP.## (McPherson.Sample #) Paint Sample Number

McPherson Square Library Paint Sample Location Key
Samples Collected by Building Conservation Associates, Inc. on Septebmer 16, 2025



Southwest Elevation

Key

MP.## (McPherson.Sample #) Paint Sample Number

McPherson Square Library Paint Sample Location Key
Samples Collected by Building Conservation Associates, Inc. on September 16, 2025

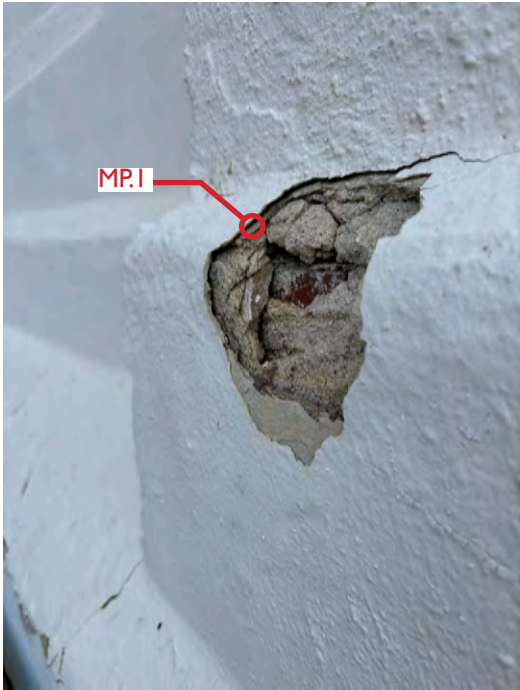


Figure 1. Pilaster base



Figure 2. Louvered oval window



Figure 3. Pediment



Figure 4. Column capital



Figure 5. Column base



Figure 6. Arched moldings above window

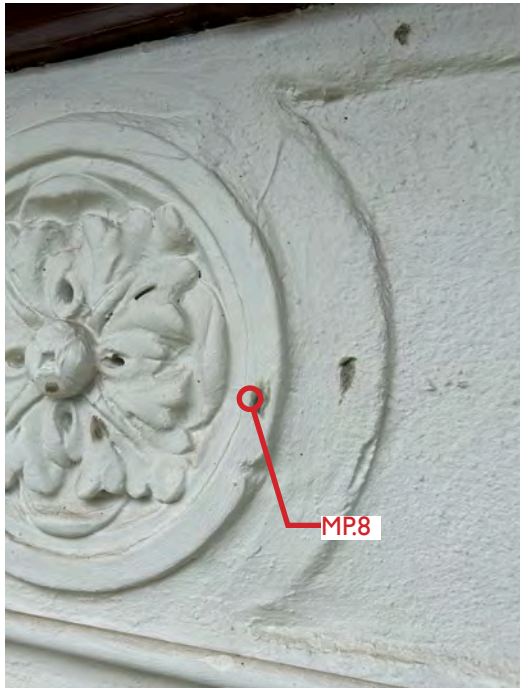


Figure 7. Rosette



Figure 8. String course



Figure 9. Arched moldings above window

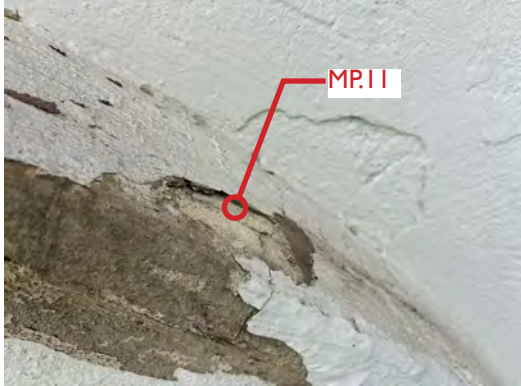


Figure 10. Arched moldings above window

Key

MP.## (McPherson.Sample #) Paint Sample Number

McPherson Square Library Paint Sample Location Key
Samples Collected by Building Conservation Associates, Inc. on Septebmer 16, 2025



Figure 11. Brick mold

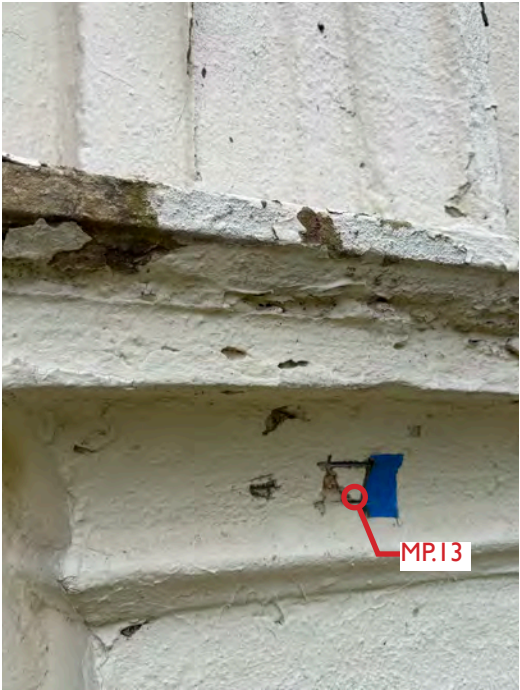


Figure 12. Pilaster capital

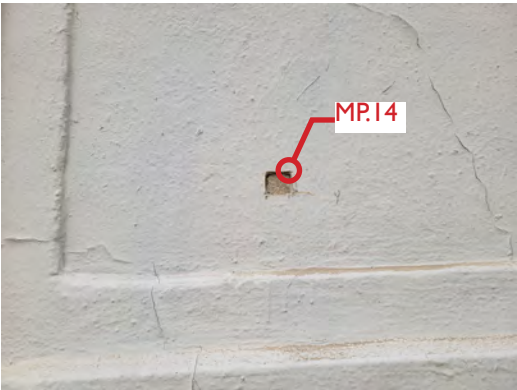


Figure 13. Recessed wall panel center

Key

MP.## (McPherson.Sample #) Paint Sample Number

APPENDIX B
PAINT SAMPLE STRATIGRAPHY SHEETS

McPherson Square Library

Materials Analysis

SAMPLE STRATIGRAPHY SHEETS



BUILDING NAME: McPherson Square Library	
CONSTRUCTION DATE: 1917	
TOTAL NUMBER OF SAMPLES: 13	
SUBSTRATE TYPE: Stucco, terra cotta, wood	
DATE SAMPLED: September 16, 2025	DATE ANALYZED: September-October, 2025
SAMPLED BY: P.Hull; M. Luo-Hita	ANALYZED BY: M. Luo-Hita; D. Krotzer
MICROSCOPE: Nikon Eclipse E200 compound fluorescence microscope	CAMERA: Nikon DS-Fi3
DESCRIPTION: Samples removed from representative exterior architectural elements.	

Materials Analysis



Pilaster base

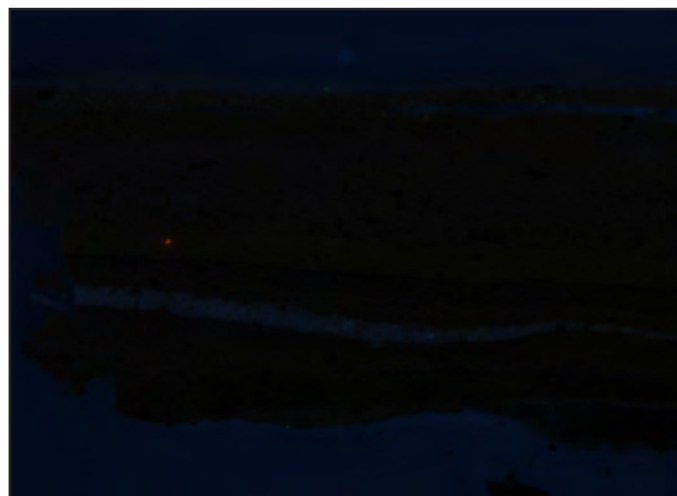
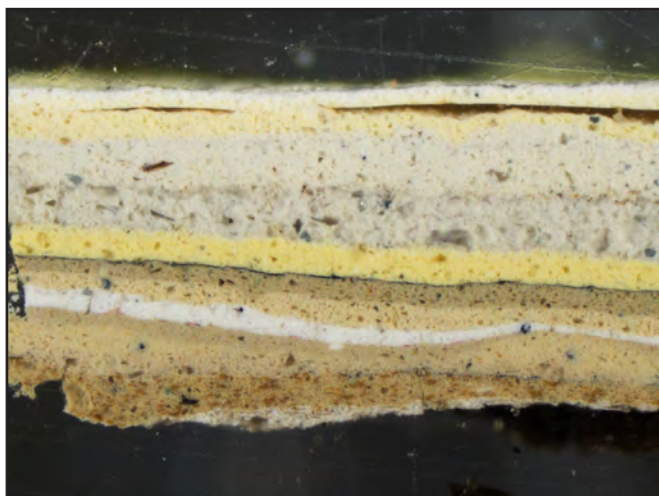
[illegible]

Bold denotes known presentation layer.

McPherson Square Library
Materials Analysis



SAMPLE #: MP.I	ROOM: Exterior
DESCRIPTION: Pilaster base	

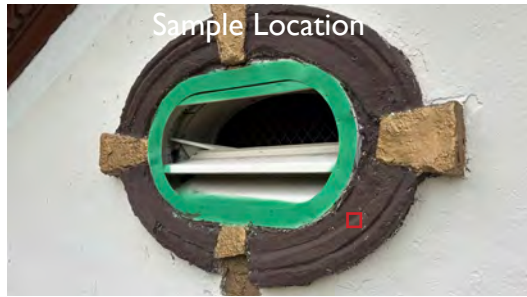


LAYER	REFLECTED LIGHT COLOR	NOTES
Substrate	Stucco	See previous page for substrate and earliest existing layer.
//		
2	White	
3	Dark orange yellow	
4	Light yellowish brown	
5	Moderate yellowish brown	
6	White	
7	Moderate orange yellow	
8	Light yellowish brown	
9	Brilliant yellow	
10	Grayish white	
11	Grayish white	
12	Light yellow	
13	Light brown	Translucent
14	White	

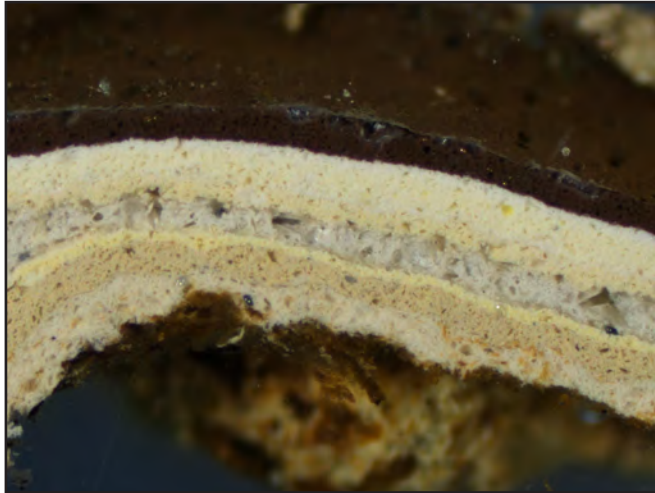
// denotes a break in the sample.

Bold denotes known presentation layer.

Materials Analysis



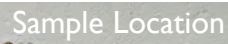
SAMPLE #: MP.3	ROOM: Exterior
DESCRIPTION: Louvered oval window	

[illegible]

// denotes a break in the sample.

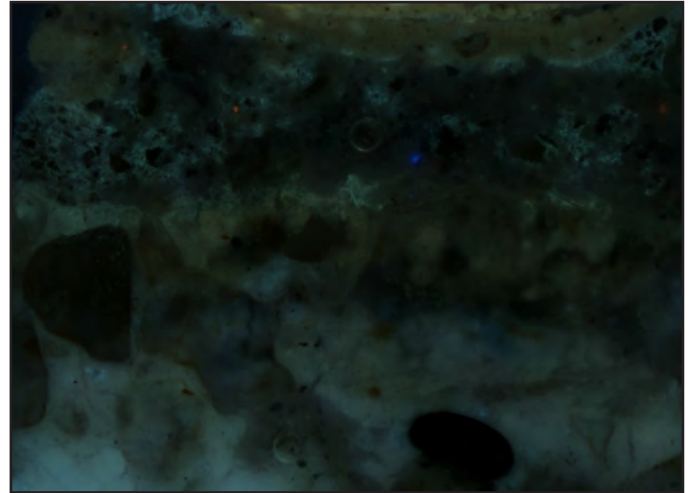
Bold denotes known presentation layer.

Materials Analysis

Pediment field[illegible]

Bold denotes known presentation layer.

Materials Analysis

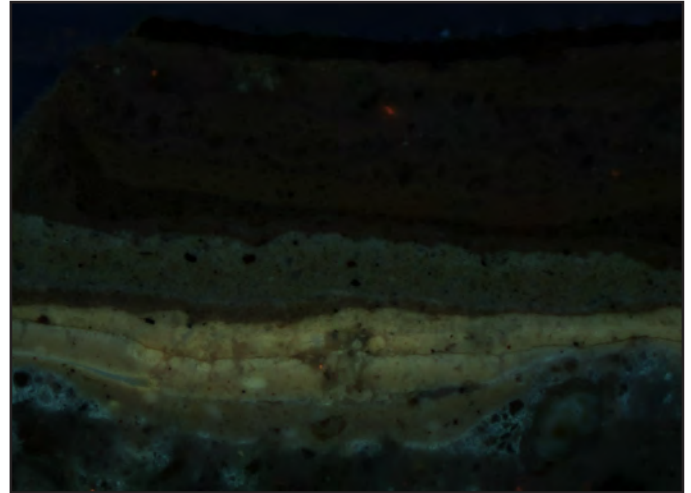
Column capital[illegible]

Bold denotes known presentation layer.

Materials Analysis



Column shaft

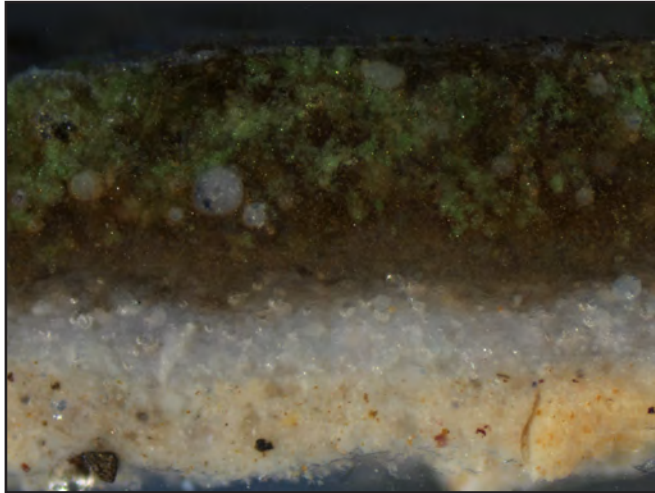
[illegible]

Bold denotes known presentation layer.

Materials Analysis



SAMPLE #: MP.6	ROOM: Exterior
DESCRIPTION: Column base	

[illegible]

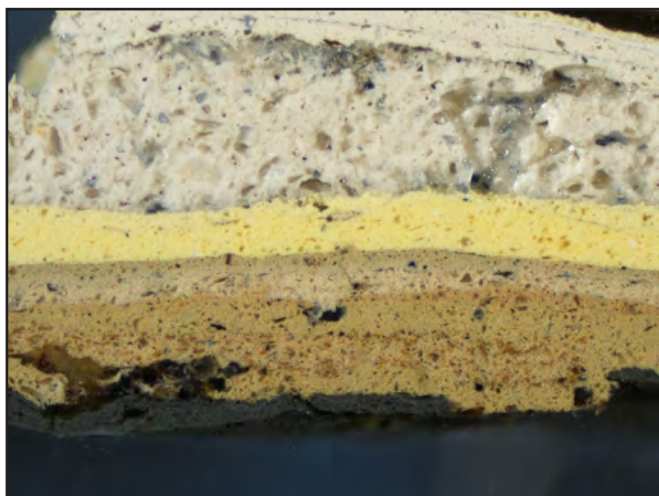
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Bold denotes known presentation layer.

McPherson Square Library
Materials Analysis



SAMPLE #: MP.6	ROOM: Exterior
DESCRIPTION: Column base	

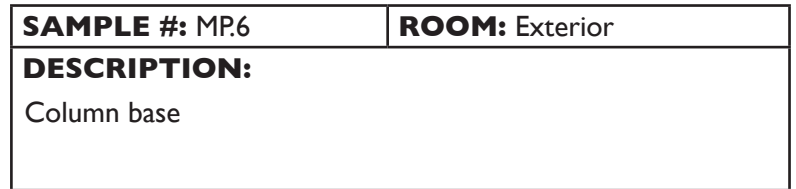


LAYER	REFLECTED LIGHT COLOR	NOTES
Substrate	Terra cotta	
//		See previous page for substrate and glaze.
2	Dark gray	
3	Light olive brown	
4	Dark orange yellow	
5	Light olive brown	
6	Grayish yellow	
7	Light yellowish brown	
8	Brilliant yellow	
9	Grayish white	
10	Grayish white	
11	Grayish white	
12	Grayish white	
13	Light yellow	
//		See next page.

// denotes a break in the sample.

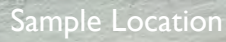
Bold denotes known presentation layer.

Materials Analysis

[illegible]

Bold denotes known presentation layer.

Materials Analysis

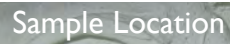


Top of arched molding

[illegible]

Bold denotes known presentation layer.

Materials Analysis

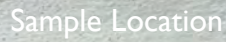


Rosette molding

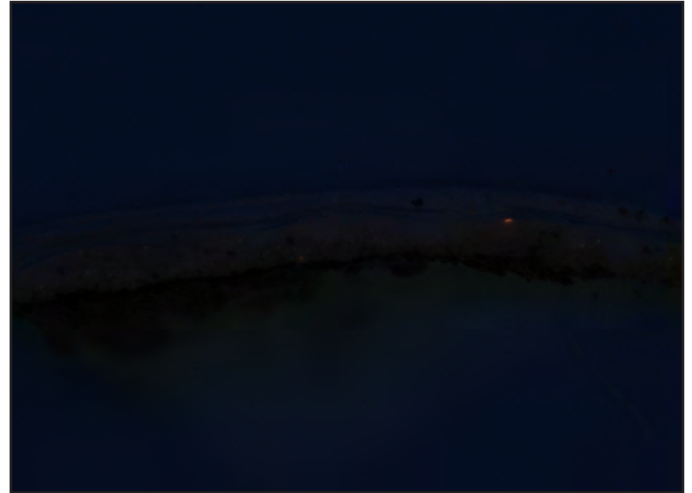
[illegible]

Bold denotes known presentation layer.

Materials Analysis



String course

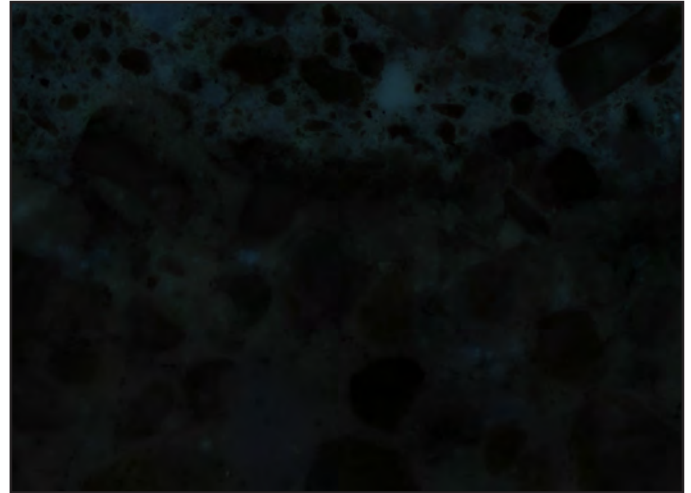
[illegible]

Bold denotes known presentation layer.

Materials Analysis



Arched molding, fascia

[illegible]

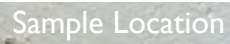
Bold denotes known presentation layer.

Materials Analysis

Arched molding, fascia[illegible]

Bold denotes known presentation layer.

Materials Analysis



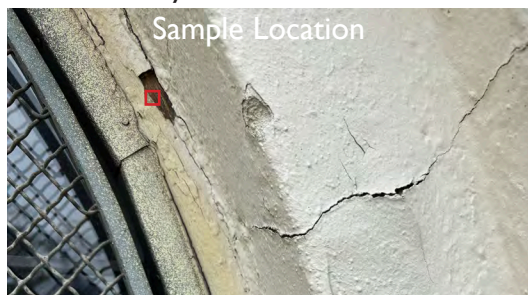
Arched molding, top

[illegible]

Bold denotes known presentation layer.

McPherson Square Library

Materials Analysis

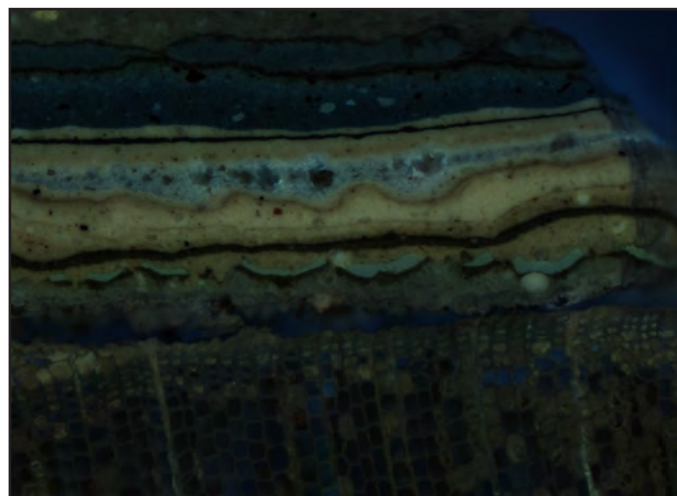
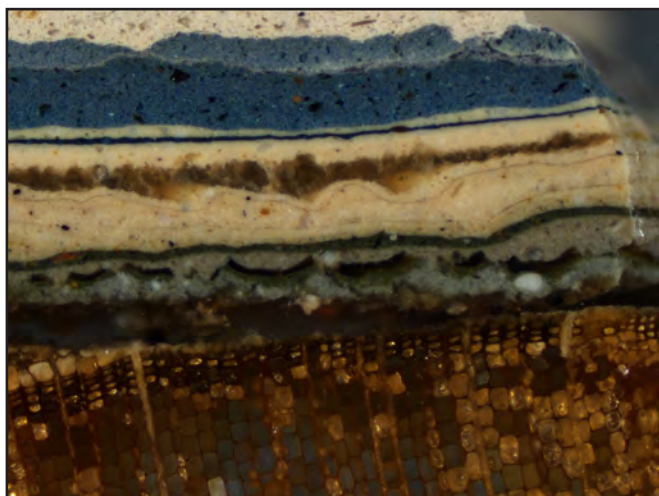


SAMPLE #: MP.12

ROOM: Exterior

DESCRIPTION:

Brick mold



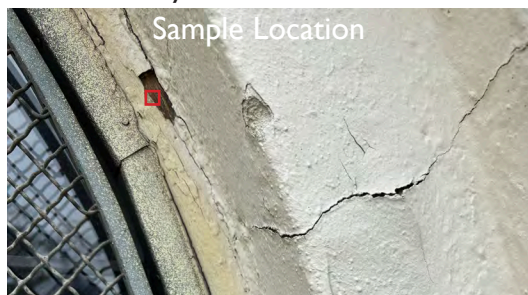
LAYER	REFLECTED LIGHT COLOR	NOTES
Substrate	Wood	
1	grayish olive green	Base color. Color match: 10G 4/2; HC-124 Caldwell Green
2	dark olive	Glossy coating, almost the same color as the terra cotta glaze on the column base. Approximate color match: 10Y 2/2; 2140-10 Fatigue Green
3	Light grayish olive	
4	Dark grayish olive	
5	Dark yellow	
6	Light orange yellow	
7	Light orange yellow	
8	Orangish brown	Transparent or translucent.
9	Light orange yellow	
10	Very dark greenish blue	
11	Light yellow	
12	Deep blue	
13	Light grayish blue	
14	Dark grayish blue	
15	Light orange yellow	
		See next page for more recent layers.

// denotes a break in the sample.

Bold denotes known presentation layer.

McPherson Square Library

Materials Analysis

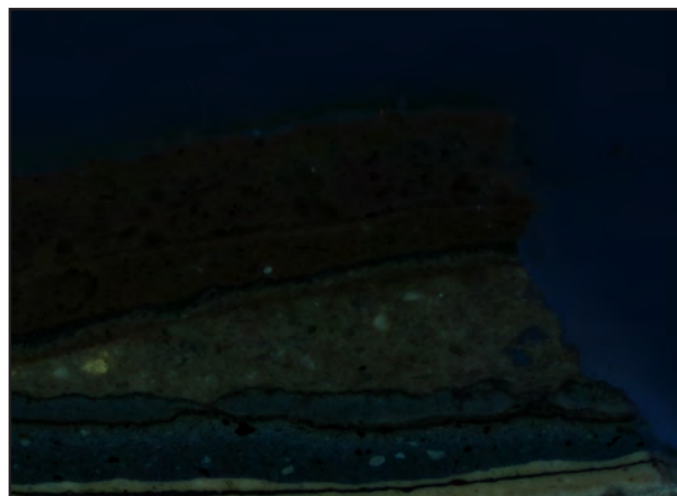


SAMPLE #: MP.12

ROOM: Exterior

DESCRIPTION:

Brick mold



LAYER	REFLECTED LIGHT COLOR	NOTES
Substrate	Wood	See previous page for early layers.
9	Light orange yellow	
10	Very dark greenish blue	
11	Light yellow	
12	Deep blue	
13	Light grayish blue	
14	Dark grayish blue	
15	Light orange yellow	
16	Grayish yellow	
17	Dark brown	
18	Light yellow	
19	Light yellow	
20	Grayish white	
21	Light yellow	
22	White	

// denotes a break in the sample.

Bold denotes known presentation layer.

Materials Analysis

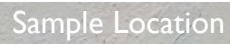


Pilaster capital

[illegible]

Bold denotes known presentation layer.

Materials Analysis

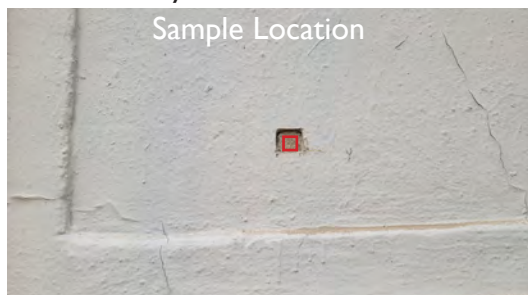


Recessed wall panel, center

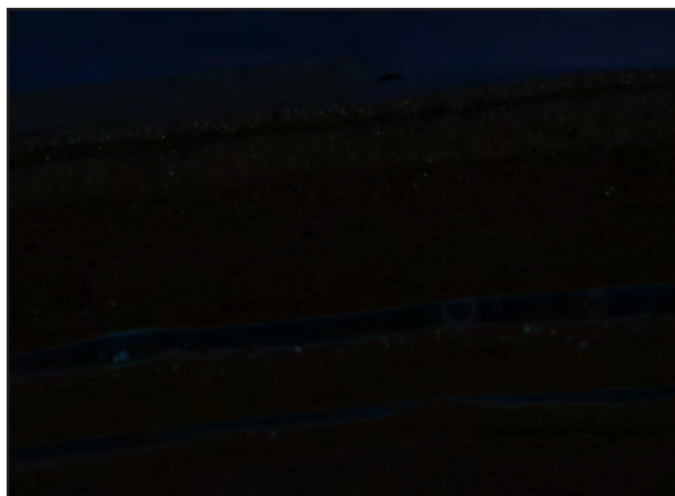
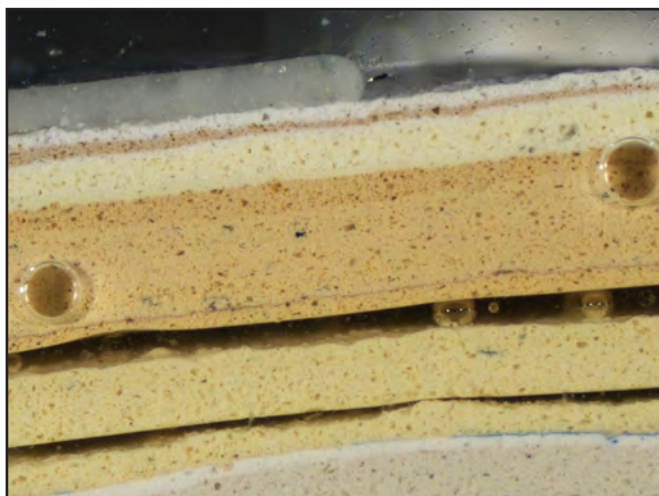
[illegible]

Bold denotes known presentation layer.

McPherson Square Library
Materials Analysis



SAMPLE #: MP.14	ROOM: Exterior
DESCRIPTION: Recessed wall panel, center	



LAYER	REFLECTED LIGHT COLOR	NOTES
Substrate	Stucco	
3	Pale grayish yellow	
4	White	
5	Light blue	Partial, thin.
6	Brilliant yellow	
7	Orangish brown	Transparent.
8	Brilliant yellow	
9	Orangish brown	Transparent.
10	Moderate orange yellow	
11	Moderate orange yellow	
12	Moderate orange yellow	
13	Light yellow	
14	White	
15	Light yellowish brown	
16	White	

// denotes a break in the sample.

Bold denotes known presentation layer.

APPENDIX C
STUCCO ANALYSIS REPORT
BY HIGHBRIDGE MATERIALS CONSULTING, INC

Stucco Analysis Report

McPherson Square Library

601 E Indiana Avenue, Philadelphia, PA 19134



Prepared for

Building Conservation Associates, Inc.

Client ID

BUIL005

Report No.

SL2117-01

Report Date

12/17/25



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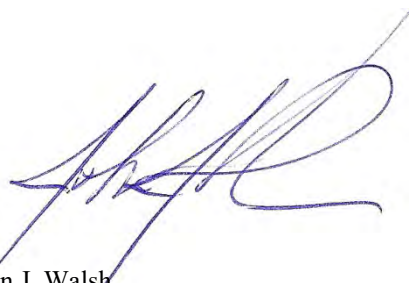
Cover Image

Photograph of the McPherson Square Library in Philadelphia, PA. Image courtesy of Ms. Melissa Luo-Hita of Building Conservation Associates, Inc.

Respectfully submitted,



Heather Hartshorn
Vice President/ Senior Chemist
Highbridge Materials Consulting, Inc.



John J. Walsh
President/ Senior Petrographer
Highbridge Materials Consulting, Inc.

1. Executive Summary

The original finish coat of one stucco sample is examined petrographically and chemically for this report to determine its composition and evaluate its condition. The stucco was reportedly taken from the ca. 1917 McPherson Square Library in Philadelphia, PA.

The finish coat contains a mixture of white portland cement, dolomitic lime, and a somewhat fine-grained natural sand. The aggregate is mid-Atlantic coastal sand with some glauconite, and the yellowish tone of the sand contributes to the pale yellow color of the finish layer (Munsell code approximately 10YR 8/2). The cement microtextures are consistent with a white portland cement from the early twentieth century, and the lime appears to have been burned from a dolomitic rock and added to the stucco as a slaked putty.

The finish coat is estimated to have a cement to lime ratio between approximately 1 : 2.3 and 1 : 3.2 by volume, and the corresponding binder to sand ratios are calculated at 1 : 3 and 1 : 2.3 by volume. Although the finish coat is calculated as a mixture that is more lime-rich than any of the formulations specified in the modern standard for portland cement-based plasters (ASTM C926-24), there are no obvious deficiencies due to the high lime content. The layer is still cohesive even though the paste is moderately soft with a relatively high permeability.

There is some evidence of microcracking and secondary gypsum deposition in the examined finish layer. These features could also weaken the finish coat relative to its original characteristics. Otherwise, there is no significant degradation of the examined layer. The finish coat is fully carbonated, which is a normal and desirable consequence of long-term curing. The stucco sample appears to remain mostly intact.

2. Introduction

On September 18, 2025, Highbridge received a stucco sample from Ms. Melissa Luo-Hita of Building Conservation Associates, Inc. (BCA) that was reportedly removed from the ca. 1917 McPherson Square Library in Philadelphia, PA. On September 24, 2025, Ms. Luo-Hita and Ms. Dorothy Krotzer of BCA held a video conference with Mr. John Walsh and Ms. Heather Hartshorn of Highbridge to discuss the multi-layered sample and the testing scope needed for this project.

According to Ms. Luo-Hita and Ms. Krotzer, they are most interested in understanding the composition and general qualities of the original finish coat of the stucco. To that end, the client has requested the laboratory perform a compositional analysis on only the yellowish finish layer, which is present between the base coats and a later gray skim coat in the provided sample. The testing includes petrographic examination and chemical analysis to identify constituents, evaluate overall condition, and estimate component proportions. An acid digestion to extract a sand sample for description and gradation is also included.

3. Methods of Examination

The petrographic examination is conducted in accordance with the standard practices contained within ASTM C1324-25. Data collection is performed or supervised by a degreed geologist who by nature of their education is qualified to operate the analytical equipment employed. Analysis and interpretation is performed or directed by a supervising petrographer who satisfies the qualifications as specified in Section 4 of ASTM C856/C856M-25.

Chemical analysis is performed in general accordance with the procedures outlined in ASTM C1324-25. Water, carbon dioxide, and aggregate weight percentages are determined gravimetrically. Oxide weight percentages are determined by inductively coupled plasma - optical emission spectroscopy (ICP-OES). While ASTM classifies C1324 as a test method, it is intended to serve as a guideline for qualified practitioners with ample experience in the various materials under consideration. Appendix X1 of the same standard indicates the need for discretion on the part of the laboratory to ensure that methods are tailored to specific mortar compositions. As such, Highbridge chooses specific digestion methods, supplementary tests, instrumentation protocols, and mathematical models to best characterize each individual mortar under consideration. Many of these are proprietary methods that have been researched internally.

The following personnel contributed to the examination:

Technician:	M. Pattie
Laboratory Assistant:	J. Negron
Analyst:	M. Florakis
Chemist:	H. Hartshorn
Petrographer:	J. Walsh

4. Laboratory Findings and Discussion

4.1 - Overall Appearance and Quality

The provided sample represents a three-coat stucco that is covered with a later cementitious skim coat and multiple coatings layers. The laboratory investigation is focused only on the original finish coat, which is about 1/8" to 1/4" thick and has a pale yellow color (Munsell code approximately 10YR 8/2). The finish layer is cohesive, but the paste is relatively soft and somewhat rapidly water-absorptive.

4.2 - Materials

The aggregate in the examined finish coat is a clean, natural quartz sand. There is minor glauconite, which is an iron-rich clay that is common in coastal sand deposits in the mid-Atlantic region of the United States. No clay linings, friable materials, or obvious organic impurities are observed. On the whole, the aggregate is considered hard, non-porous, and durable for use in masonry mortars and stuccos. A sample of the sand was extracted from the mortar through acid digestion. The extracted material is uniform with a light yellowish-brown color (Munsell code approximately 1.5Y 6/3). The dark glauconite particles give the sand a peppered appearance. The finer portion of the sand has a slightly darker, richer color (Munsell code approximately 2.5 Y 5/4), which is likely due to the higher concentration of glauconite debris and iron-rich clay in this fraction.

The sand is soft-textured and somewhat fine-grained. The nominal top size is at the No. 16 sieve, and the peak abundance is between the No. 30 and No. 50 sieves. If compared to the permissible gradation limits for aggregates used in modern portland cement-based plasters (ASTM C897-25), there is technically more sand passing the No. 16 and No. 30 sieves than specified in the modern standard. That said, there is greater latitude allowed for gradation profiles for sands used to achieve special textures in plaster finish coats.

The binder in the finish coat is a mixture of white portland cement and dolomitic lime. The use of a white cement is indicated by the lack of iron-bearing ferrite observed petrographically (Table 7.1). The medium grind of the white cement is at least consistent with the reported ca. 1917 manufacture. Though grind quality is less diagnostic in white portland cement than in gray varieties, the agglomerate sizes are on the coarser end of those expected for white cements. This suggests that the cement represents a relatively early product, likely from no more than a couple of decades after white portland cements became commercially available around 1905.

The binder matrix is lime-rich, though there is only a low concentration of undispersed lime grains. Where present, the lime is carbonated and mostly internally nondescript. There is some rare fired quartz associated with the lime, which likely represents minor impurities in the source rock. The high magnesium content measured in the chemical analysis (Table 6.2) indicates that the lime is a dolomitic variety. The lack of fine particulate texture suggests that the lime was not added as a prepackaged dry hydrate. Instead, it was likely incorporated as a slaked putty.

4.3 - Component Proportions

The chemical analysis (Section 6) is used to estimate the component proportions of the finish coat. Calculating the lime as a dry hydrate, the cement to lime ratio is estimated to be between 1 : 2.3 and 1 : 3.2 by volume. The corresponding binder to sand ratios are calculated at 1 : 3.0 and 1 : 2.3, respectively. When compared to the modern standard for portland cement-based plasters (ASTM C926-24), the examined mix would not satisfy any of the categories specified in the standard due to the high lime content. That said, it is not unusual to find historical stucco mixes that do not comply with today's standards.

4.4 - Original Placement

Based on the petrographically-examined sample, the constituents of the finish coat were well-blended and the mix water was thoroughly incorporated. The finish coat is compact and well-consolidated. The total air content is estimated at 6-8% by volume. There are some microscopic shrinkage cracks, but these are highly typical of lime-rich mixtures. The qualities of the cured product are consistent with the estimated lime-rich composition. Though the layer is cohesive, the matrix is relatively soft and permeable.

The examined stucco is intact, and the contacts between each successive layer are relatively planar and compact. That said, the examined finish coat detached somewhat easily from the underlying brown coat during subsampling. This process left some minor residues of the finish coat attached to the brown coat, indicating that the detachment occurs mostly within the finish coat. The outer surface of the finish coat is covered with a later cementitious skim coat, and this material is intimately adhered to the original finish layer. As such, the original finish texture and appearance of the stucco cannot be evaluated.

4.5 - Condition and Service Performance

The binder paste is carbonated across the full depth of the finish coat (up to 6 millimeters). Carbonation is a normal and desirable consequence of long-term exposure. There is no evidence of paste degradation in the finish coat of the examined sample. However, there does appear to be some expansive distress related to secondary gypsum deposition. Gypsum is observed within shrinkage cracks and air-voids throughout the binder paste. It is also observed filling microcracks within some of the glauconite sand grains and in concentric cracks adjacent to some of the sand grains. Although the gypsum is often associated with the glauconite particles, it is not necessarily derived from this constituent. The glauconite may simply represent a softer material that is more susceptible to expansive distress than the rest of the quartzose sand.

Despite the presence of the fine cracks described above, there is no interconnected crack structure that creates a larger plane of weakness in the plaster. Still, these microcracks may weaken the finish layer slightly compared to its original quality. That said, the finish layer remains cohesive and visibly intact in the examined sample.

4.6 - Commentary on Other Materials

The pale yellow finish coat that was the focus of the analysis is placed directly over base coats that have a light brown color. The visual difference between the base and finish coats is subtle, and this subtle color difference could be caused by a lower glauconite content in the base coat sands. However, this was not confirmed through a full petrographic examination of the base coats or sand extraction from these layers.

The examined finish coat is covered with a brownish-gray skim coat that is visually distinct and appears to represent a later cementitious application. Given the portland cement-rich character of this material, the later skim coat could potentially serve as a source of the secondary gypsum observed in the original finish coat. While the secondary gypsum deposits in the finish layer appears more concentrated near the contact with the skim coat, this could also occur if the gypsum was derived from some external source prior to the application of the skim coat. This would also have created a greater concentration of gypsum near the outer surface of the original finish layer. A petrographic examination of the full cross section of the stucco would need to be performed to better understand the distribution of this salt and any related cracking distress.

5. Aggregate Sieve Analysis

An aggregate sample was extracted from the mortar by digesting the sample in a hydrochloric acid solution sufficient to decompose the binder. The fines were decanted off for separate processing to remove undigested binder through a subsequent base digestion. What remained was cleaned, dried, and graded through a standard sieve stack.

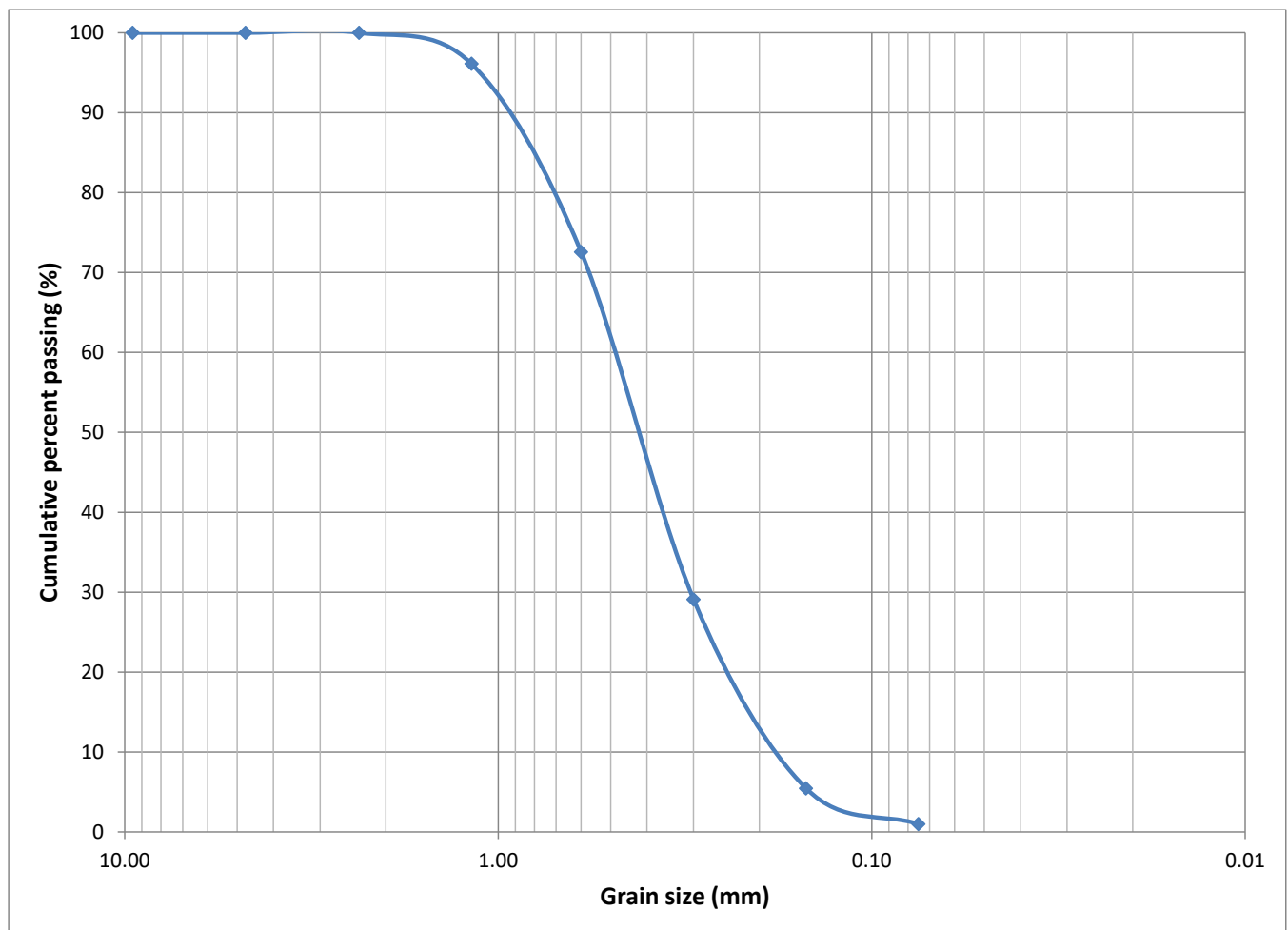
The decanted fines were found to consist mostly of clay that is interpreted to represent glauconite debris and iron-based material that was present as linings on the quartz sand. This material is presented as the "fines" in the table below. This is separated from the finest fraction of the graded sand, which consists mostly of silt and is presented as the fraction retained on the "pan" in the table below.

Table 5.1: Chemical Digestion Data - Weight Retention

Sieve size	Retention (g)	Cumulative passing (%)	Cumulative retained (%)
No. 8	0.00	100.0	0.0
No. 16	0.86	96.1	3.9
No. 30	5.22	72.6	27.4
No. 50	9.64	29.1	70.9
No. 100	5.24	5.5	94.5
No. 200	0.99	1.0	99.0
Pan	0.10	0.5	99.5
Fines	0.12	0.0	100.0
Fineness modulus			1.97

Chart 5.1: Aggregate Sieve Analysis

The following chart presents the particle size distribution curve for the extracted sand sample. The chart plots the data from the cumulative passing values in Table 5.1. The fine end of the curve is terminated at the No. 200 sieve. Any silt and clay components are not graded beyond this point. Note that the gradation curve demonstrates the broad particle size distribution of the sand.



6. Chemical Analysis

Chemical analysis was performed in general accordance with methods contained within ASTM C1324. The insoluble residue was determined directly from the initial digestion rather than through the digestion of a separate aliquot. Due to the detection of some secondary gypsum, a sulfite measurement was also included. Methods contained within ASTM C114 were used for this part of the analysis.

Table 6.1: Chemical Analysis Results

Sample ID	Finish Coat
Component (wgt. %)	
SiO ₂	1.86
CaO	10.08
MgO	3.25
Al ₂ O ₃	0.40
Fe ₂ O ₃	0.18
SO ₃	3.41
Insoluble residue	66.76
LOI to 110 °C	0.86
LOI 110 °C to 550 °C	5.55
LOI 550 °C to 950 °C	6.12
Measured total	98.47

The binder is interpreted to contain a mixture of white portland cement and lime. While it is not possible to accurately solve the composition of either component from the combined chemistry, it is worthwhile to review relationships between chemical elements. To remove the diluting effect of the sand, the five major oxides derived from the binder are normalized to a 100% weight yield. This normalizes the binder components to a dry weight basis.

Table 6.2: Normalized Soluble Oxide Chemistry

Sample ID	Finish Coat
Component (wgt. %)	
SiO ₂	11.8
CaO	63.9
MgO	20.6
Al ₂ O ₃	2.5
Fe ₂ O ₃	1.1
CaO/SiO ₂	5.4
SiO ₂ /Fe ₂ O ₃	10.3
SiO ₂ /MgO	0.6

The following features are worth noting:

- The measured SiO₂/Fe₂O₃ ratio is lower than that expected for a white portland cement. For reference, gray portland cements usually have ratios less than 10 and white portland cements usually have ratios higher than 15. However, the petrographic observations clearly indicate that the cement is a white variety.
- The CaO/SiO₂ ratio is much higher than the 3.0 ratio expected for portland cement alone. This indicates the presence of a notable lime addition.
- The sample has a high MgO content, indicating that the lime is a dolomitic rather than high-calcium variety. This is demonstrated by the SiO₂/MgO ratio, which is much lower than expected for a white portland cement alone (typically near 20).

There is a notable amount of secondary gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) detected petrographically in the finish coat. This may elevate the CaO in the measured oxide chemistry relative to the original binder. In order to correct for this, a proportional amount CaO is subtracted from the oxide chemistry relative to the measured SO_3 . From there, the white portland cement is calculated assuming a typical chemistry for this product. Remaining calcium and magnesium are calculated as dry lime hydrate. The aggregate is fully represented by the insoluble residue. This estimates the minimum lime content that can be calculated from the measured chemistry. Technically, this calculation also requires the lime to have an anomalously high MgO content. However, this error is ignored for the sake of producing an end member for the estimated proportional range.

However, it is possible that some of the calcium in the secondary gypsum was originally part of the calcareous binder rather than being fully derived from an external source. If this were the case, then the first calculation would underestimate the original lime content. A maximum lime content can be calculated by performing the same calculations without first attributing a portion of the measured calcium to the secondary gypsum. That said, this overestimates the lime content since it is highly unlikely that all of the calcium in the gypsum was leached from the binder and converted to gypsum. In fact, there is no evidence of any notable paste degradation that would suggest this has occurred. Regardless, the actual proportions of the finish coat likely lie somewhere between the two estimates and the calculated end members indicate that the mixture is relatively lime-rich and moderately sanded.

Table 6.3: Calculated Components

Sample ID	Finish Coat	Finish Coat
Assumption	Minimum lime	Maximum lime
Component		
Portland cement (wgt. %)	10	9.4
Lime expressed as dry hydrate (wgt.)	9.4	13
Sand (wgt. %)	81	78
Cement : lime ratio (by volume with lime as dry hydrate)	1 : 2.3	1 : 3.2
Binder : sand ratio (by volume with lime as dry hydrate)	1 : 3.0	1 : 2.3
Cement : lime ratio (by volume with lime as putty)	1 : 1.8	1 : 2.5
Binder : sand ratio (by volume with lime as putty)	1 : 3.5	1 : 2.7

Notes:

1. Volumetric ratios are calculated assuming bulk weights for portland cement, hydrated lime, and damp, loose sand of 94 lbs./ft.³, 40 lbs./ft.³, and 80 lbs./ft.³, respectively.

Two separate volume estimates are given in the table above. One is given with the lime in the form of a dry hydrate despite the fact that the lime mortar examined for this report could have been added as a putty rather than a prepackaged hydrated lime. Calculating the lime as a dry hydrate is convenient because it does not have to take into account the mix water used in a lime putty. Nonetheless, it is generally assumed that a volume of dry hydrate will lose approximately 20% of its volume when water is added to produce a putty of stiff consistency. This assumption is the basis for the volume estimate reported for lime putty. This ratio is derived from the dry hydrate calculation.

It should also be noted that where volume proportions are given, these are based on estimated original bulk densities of the materials. However, limes are subject to great variation in volume due to factors such as settling or “fluffing” in dry powders and mix water content in putties. The table also presents the weight percentages of the dry ingredients (portland cement, dry hydrated lime, and sand). These are more accurate as they represent direct measurements of material mass and are not based on assumptions of bulk density. Of course, all of these discussions may be academic since it is usually desirable to modify the original design if modern materials will be used to replace their historic counterparts. The findings of a mortar analysis are best used to constrain possible repair designs rather than as a prescription for a specific formulation.

7. Petrographic Data

Table 7.1: Petrographic Data

Sample ID	Stucco
As-received description	
Description	The sample consists of two cut panel pieces that include the outer surface of the stucco measuring approximately 4" x 5" and 4" x 3", though the latter is broken at an angle. There are also two smaller pieces of stucco that do not include the outer surface. The stucco consists of the following layers: • A scratch coat that is approximately 1/8" to 1/4" thick and has a light brown color. • A brown coat that is approximately 3/8" thick and has a light brown color. • A presumably original finish coat that varies from 1/8" to 1/4" in thickness and has a pale yellow color. • A dark brownish-gray skim coat that is up to 1/8" thick. • Multiple coatings layers. The pale yellow layer that is suspected to represent the original finish coat is the focus of the investigation, and the descriptions below apply only to this material.
Inner surface	The inner surface is mostly planar and compact against the underlying, brown base coat. There is a single one-centimeter wide area where there is an approximately 1/8" thick gray mixture between the base coat and the finish coat. Although the pieces are intact, there appears to be a disbond between the base and finish coats.
Outer surface	The outer surface is planar and covered with a well-bonded dark brownish-gray skim coat.
Appearance	Freshly-exposed surfaces have a dull luster and a pale yellow color (Munsell code approximately 10YR 8/2).
Visible inclusions	None observed
Hardness/friability	The paste is moderately soft, but the material is cohesive.
Absorptivity	The mortar matrix is somewhat rapidly water-absorptive.
Cracking	None observed
Mineralizations	None observed
Sand	
Lithology	The sand is siliceous natural sand consisting primarily of quartz, much of which is lined with iron oxide or iron hydroxide. Glauconite is a minor component. Most is fresh, though a low proportion has altered to hematite. There is also a minor to trace abundance of feldspar. Trace heavy accessory minerals, including amphibole and tourmaline, are also detected.
Appearance	The extracted sand sample is uniform and semi-translucent to semi-opaque with a light yellowish-brown color (Munsell code approximately 1.5Y 6/3). The glauconite is observed as opaque, black flecks that give the sand a peppered appearance. The extracted fines have a slightly darker, richer brown color (Munsell code approximately 2.5Y 5/4).
Gradation	The sand is broadly graded and somewhat fine-grained. The nominal top size is at the No. 16 sieve, and the peak abundance is between the No. 30 and No. 50 sieves. The fines content is minor.
Shape/aspect ratio	The particles are equidimensional with subrounded to rounded shapes.
Clay coatings/friable materials	None observed
Organic impurities	None observed
Binder matrix	
Paste uniformity	Homogeneous
Capillary porosity	Moderately high to high
Microscopic shrinkage cracking	Fine microscopic shrinkage cracks are present in relatively high concentration. Though these tend to be oriented across the thickness of the finish coat, there are also some polygonal cracks.
Residual calcium hydroxide	Not identified
Evidence for admixtures¹	None detected

Table 7.1 (cont'd.): Petrographic Data

Sample ID	Stucco
Binder residuals	
Binder type	White portland cement and hydrated lime
Hydraulic cement	There is a relatively high abundance of portland cement residuals, consisting mostly of agglomerates of former belite and alite. There is no interstitial iron-bearing ferrite. The cement is somewhat finely ground with many particles passing the No. 200 sieve. However, a moderate proportion of the cement residuals are retained on the No. 200 sieve with some approaching and rarely retained on the No. 100 sieve.
Lime	Undispersed lime grains are observed in low concentration as mostly nondescript, carbonated particles up to a maximum size of about one millimeter in diameter. Impurities are rare, though there is occasionally evidence of some fired quartz within the lime grains and distribution throughout the binder matrix.
Pozzolans/SCMs²	None detected
Other	None detected
Pigment	
Concentration	None detected
Distribution	n/a
Composition	n/a
Particle size	n/a
Color of extracted pigment	n/a
Other materials	
Details	The examined finish coat is attached to base coat(s) containing a comparatively coarser quartzose sand and a gray portland cement-based binder. Over the examined finish coat is a later skim coat containing a mixture of gray portland cement, dry hydrated lime, and a different siliceous natural sand.
Placement features	
Constituent distribution	The constituents are well-mixed with no sand streaks or coarse binder lumps.
Mix water	There is no evidence of inappropriate retempering.
Compaction/consolidation	The mixture is compact and well-consolidated.
Estimated air content/structure	The total air content is estimated at 6-8% by volume. Voids are mostly subrounded to deformed in shape and generally less than 0.5 millimeters in diameter.
Paste-sand interfaces	Sand grains are well-coated with binder.
Secondary effects	
Carbonation	The binder paste is fully carbonated.
Paste alteration	None detected
Cracking	Fine, gypsum-filled polygonal cracks are present within and extend out of some of the glauconite particles. There are also some concentric cracks around glauconite and, to a lesser extent, other aggregate grains. These cracks are also typically filled with secondary gypsum.
Mineral deposits	Secondary gypsum is present lining voids and filling shrinkage cracks throughout the finish layer. As mentioned above, the gypsum also fills cracks within glauconite particles and adjacent to a low proportion of aggregate grains. The gypsum deposits appear more concentrated near the outer surface of the finish coat, but do not extend into the later skim coat. The gypsum and cracking do extend into the underlying base coats, though these secondary features are less concentrated deeper in the stucco.
Surface erosion/weathering	The outer surface of the finish layer cannot be evaluated since it has been covered with a later skim coat. There is no evidence of the original exposed surface and no evidence of any weathering along the surface.

Notes:

1. Organic admixtures or soluble inorganic additives cannot be detected petrographically, though their effects on paste microstructure can sometimes be discerned.
2. SCMs = supplementary cementitious materials.

Appendix I: Photographs and Photomicrographs

Microscopic examination is performed on an Olympus BX-51 polarized/reflected light microscope and an Olympus SZ40 stereoscopic microscope. The polarized light microscope is fitted with a Tucsen M1chrome 5 Pro 5MP digital camera. The stereoscopic microscope is used for simple magnification. Sample types examined under this microscope include fractured surfaces, fine constituents extracted through chemical or physical means, or honed or polished cross sections. The polarized light microscope (PLM) magnifies but also employs principles of optical crystallography. The most common sample preparation for the PLM is the petrographic thin section. For this preparation, cross-sectioned samples are mounted to glass slides and are milled to a thickness sufficient to allow light to be transmitted through the material. These are usually prepared without water and with minimal heat to avoid altering minerals that are water or temperature-sensitive. In many cases, the samples are impregnated with a low-viscosity, blue-dyed epoxy. When so treated, blue areas represent some type of void space (e.g., air-voids, capillary pores, cracks, etc.). The polarized light photomicrographs are taken using a variety of optical settings chosen to best demonstrate the feature(s) of interest. These are distinguished as follows:

Plane polarized light (abbreviated as PPL)

This method uses the refractive power of different constituents to produce an artificial sense of surface relief. Otherwise, the method is the closest to a simple magnification of the material. The setting is often used to demonstrate granular relationships or microstructure. Pore spaces and cracks are observable with this setting if the blue-dyed epoxy is used.

Conoscopic polarized light (abbreviated as CPL)

In this setting, the transmitted light is condensed just before passing through the thin section. The method tends to bring colors or finer particulates into higher contrast at the expense of image sharpness. The setting is often used to image grain boundary failures in dimension stone, pigment particulates in binders, or gel phases in the micropores of cement pastes.

Cross polarized light (abbreviated as XPL)

The setting places the thin section between two pieces of polarizing film oriented at 90° to one another. In isotropic materials (e.g., glasses, simple salts), all light is absorbed and the materials appear black. In anisotropic crystals, two light rays traveling at different speeds are produced within the thin section and these offset waves interfere at the upper polarizing film. The interference produces a color that can be used to calculate properties of the crystal structure and aid in identification of mineral species. In essence, the colors are artificial. It should be noted that color is a function of orientation and color differences do not necessarily indicate material differences.

Compensator plates

When in XPL mode, full-wave or quarter-wave compensator plates may be inserted into the light path to add or subtract interference. Technically, these methods are used to calculate properties of the crystal structure. However, they can also be used to alter the image appearance to help improve contrast between different constituents. They can also reveal preferred orientations in some materials (e.g., oriented residual crystallinity in fired ceramics).



Figure 1: Photographs of the stucco sample provided to Highbridge for analysis. The left image shows the outer surface of the stucco, which is mostly covered with a dark brownish-gray skim coat and multiple coatings layers. There are small areas along the edge where some of the skim coat is fractured and the original pale yellow finish coat is visible beneath. The right image shows the inner surface of the stucco sample. This mostly shows the light brown scratch coat at the base of the stucco.

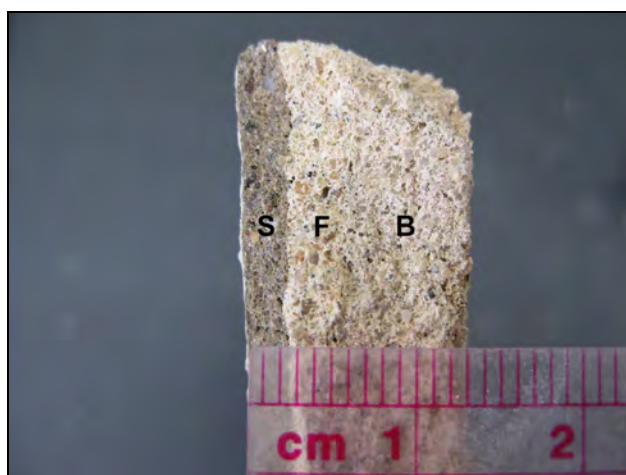


Figure 2: Photograph showing a cross section of the stucco with the outer surface toward the top of the image. The finish coat (F) is the focus of the testing. This has a pale yellow color. It is visually distinct from the underlying light brown base coats (B) and the later brownish-gray skim coat (S).



Figure 3: Photographs illustrating the sand sample extracted from the finish coat. The total extraction is shown at left. The sand is uniform with a light yellowish-brown color and fine, dark glauconite flecks. At right, the sand is shown after gradation through a standard sieve stack. The sand is broadly-graded and somewhat fine-grained.

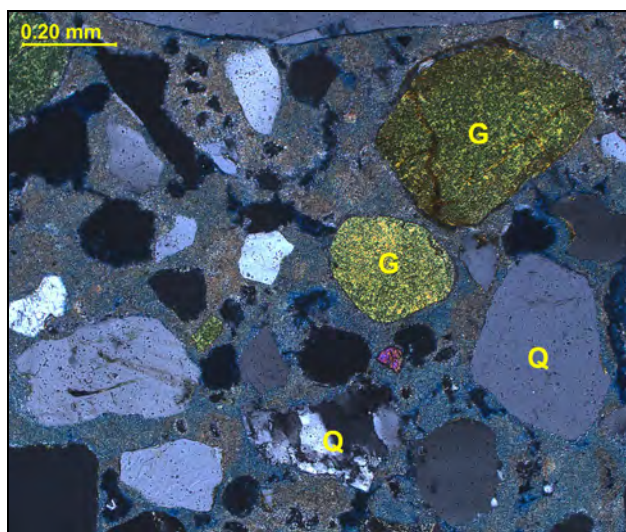


Figure 4: XPL photomicrograph showing the composition of the sand in the finish coat. The aggregate consists primarily of quartz (Q) with minor glauconite (G). The composition is typical for coastal sand deposits of the mid-Atlantic region.

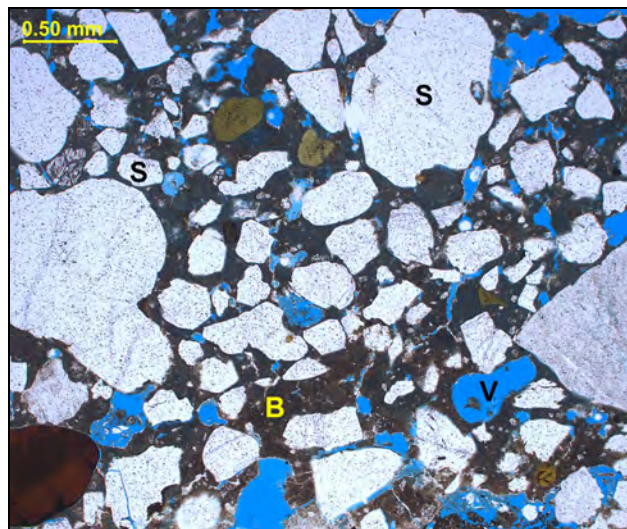


Figure 5: PPL photomicrograph illustrating the overall microtexture of the examined finish coat. The sand (S) is soft-textured, relative-fine grained, and evenly distributed throughout the matrix. The binder (B) is uniformly developed and has a moderately high to high capillary porosity, as indicated by the absorption of the blue-dyed epoxy used in the sample preparation. The finish coat is compact and well-consolidated. Air-voids (V) are not excessive.

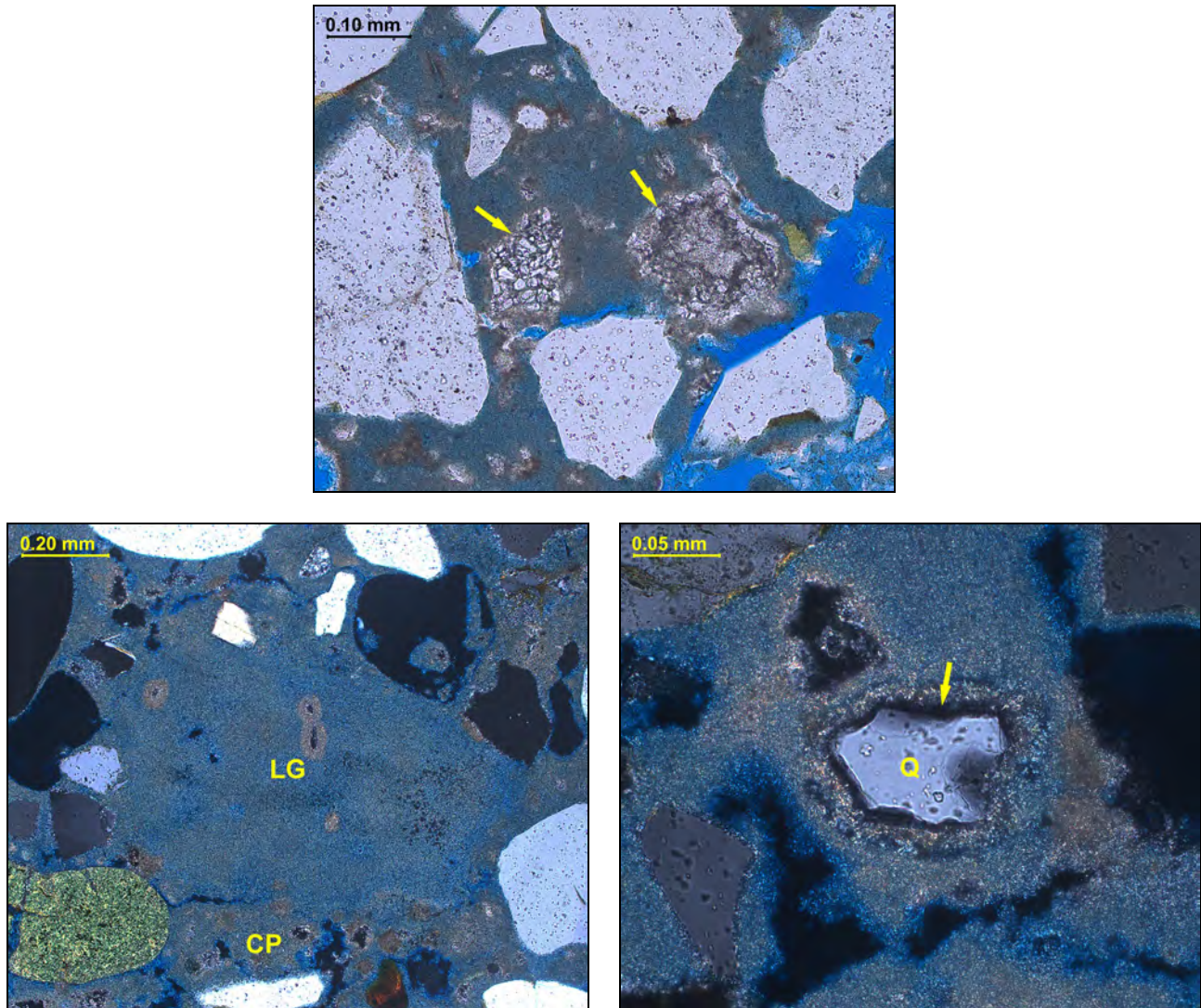


Figure 6: Photomicrographs illustrating the binder constituents in the finish coat. (Upper PPL image) The arrows indicate white portland cement residuals. The lack of iron-bearing ferrite identifies the cement as a white rather than gray variety. The microtextures of the cement are at least consistent with the reported ca. 1917 construction date. (Lower left XPL image) Undispersed lime grains (LG) are present in low concentration as relatively coarse, mostly nondescript particles. Both the lime grains and the adjacent paste (CP) are carbonated, as indicated by their golden color under crossed polars. (Lower right XPL image) Though impurities associated with the lime are rare, there are occasional particles of fired quartz (Q) that are surrounded by rims of fused glass (arrow).

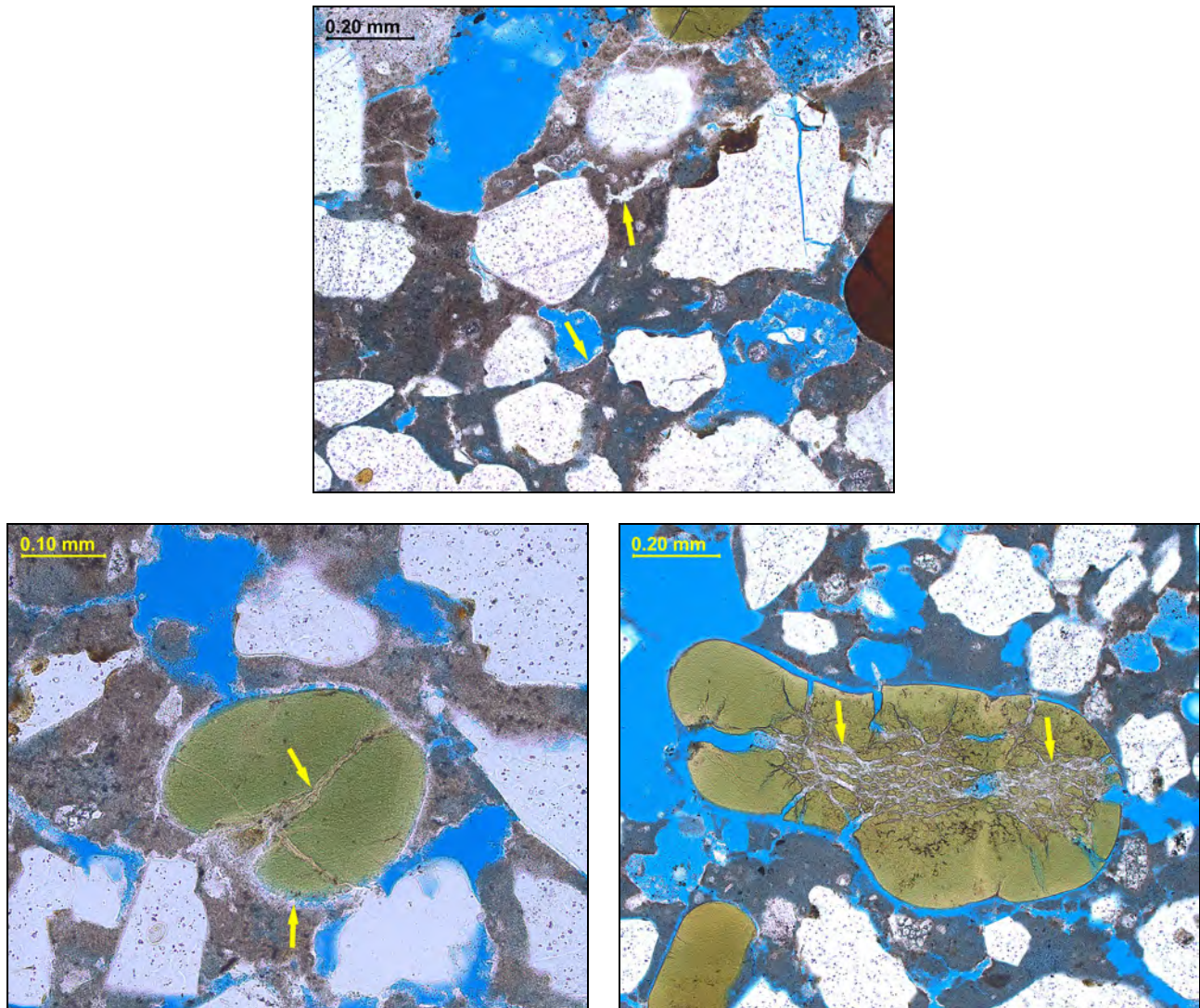


Figure 7: PPL photomicrographs illustrating secondary features in the finish coat. (Upper image) Secondary gypsum (arrows) is observed lining voids and filling shrinkage cracks throughout the finish layer, though this appears more concentrated near the outer surface. (Lower images) There are also gypsum-filled cracks (arrows) within some glauconite sand grains. The image on the left also shows gypsum lining a concentric crack around the glauconite sand particle.