

BID DOCUMENTS: October 29, 2024

PROJECT MANUAL

VOLUME 2 OF 2: DIVISIONS 04-33

City School District of the City of New Rochelle

2023 Capital Project – Phase 1

New Rochelle High School	SED #66-11-00-01-0-001-030
Albert Leonard Junior High School	SED #66-11-00-01-0-002-016
Henry Barnard School	SED #66-11-00-01-0-004-015
George M. Davis Elementary School	SED #66-11-00-01-0-006-012
Jefferson Elementary School	SED #66-11-00-01-0-007-016
William B. Ward Elementary School	SED #66-11-00-01-0-013-016

CSArch Project No. 188-2301.01



The design of this project conforms to applicable provisions of the New York State Uniform Fire Prevention and Building Code the New York State Energy Conservation Construction Code and the Manual of Planning Standards of the New York State Education Department, and the New York State Department of Labor Code Rule #56.

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SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Decorative concrete masonry units.
 - 3. Acoustic Masonry Units.
 - 4. Face brick.
 - 5. Stone trim units.
 - 6. Mortar and grout.
 - 7. Reinforcing steel.
 - 8. Masonry joint reinforcement.
 - 9. Ties and anchors.
 - 10. Embedded flashing.
 - 11. Miscellaneous masonry accessories.
 - 12. Cavity-wall insulation.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section "Structural Steel Framing."
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels for unit masonry, furnished under Division 05 Section "Metal Fabrications."

1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
- B. Match Existing: Material that is noted to match existing will match the entire masonry system including the masonry size, shape color, texture as well as the mortars size color

texture and joint finish. Metric sized masonry is not to be used as a match to imperial sized units.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.
- B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602 and Tables 2105.2.2.1.1 & 2105.2.2.1.2 in the Building Code of New York State.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection: For the following:
 - 1. Decorative concrete masonry units, in the form of small-scale units.
 - 2. Face brick, in the form of straps of five or more bricks.
 - 3. Colored mortar.
- D. Samples for Verification: For each type and color of the following:
 - 1. Decorative concrete masonry units.
 - 2. Face brick, in the form of straps of five or more bricks.
 - 3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
 - 4. Weep holes/vents.
 - 5. Accessories embedded in masonry.

- E. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements and FM2000.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports, per Building Code of New York State 2105.4 and ASTM C 780 for mortar mixes required to comply with property specification.
 - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602 and Tables 2105.2.2.1.1 & 2105.2.2.1.2 in the Building Code of New York State.
- H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

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

- C. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 - 1. Mortar Test For each mix required, per ASTM C 780 and Building Code of New York State 2105.4.
 - 2. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019 and Building Code of New York State 2105.5.
- D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches (400 mm) long in each exterior wall mockup.
 - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
 - c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include metal studs, sheathing, veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
 - 2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
 - 3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
 - 4. Protect accepted mockups from the elements with weather-resistant membrane.
 - 5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

- b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
- 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
 - 2. Where one (1) wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least twelve (12) hours and concentrated loads for at least three (3) 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 meet 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-conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS602 and Building Code of New York State 2104.3.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide bullnose units for (Interior) outside corners, unless otherwise indicated.
 3. Provide 'L' shaped blocks at all outside corners of CMU walls, unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for (exterior) exposed units .
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water, or leaks on the back of test specimen.
 - a. Available Products:
 - 1) Addiment Incorporated; Block Plus W-10.
 - 2) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
 - 3) Master Builders, Inc.; Rheopel.
 - 4) Forrer Industries; Dry-Block.
- C. Concrete Masonry Units: Building Code of New York State 2103.1 and ASTM C90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
 2. Weight Classification: Lightweight. Normal weight CMU shall be for load bearing walls as indicated on structural drawings.
 3. Size (Width): Manufactured to dimensions 3/8-inch less than nominal dimensions.
 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample or where indicated on the drawings to "match existing", match the adjacent color and texture.
 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
- D. Decorative Concrete Masonry Units: ASTM C90.
1. Basis of Design: Westbrook Concrete Block.
 - a. Approved equal: A. Jandris Block.

2. Type: Architectural CMU.
3. Density Classification: Normal weight.
4. Texture: Ground-face.
5. Size: 8" x 8" x 16" nominal.
6. Finish: As selected by Architect from manufacturer's full range.

2.4 BRICK

A. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.

B. Face Brick: ASTM C 216 , Grade SW , Type FBS .

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
5. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
6. Application: Use where brick is exposed, unless otherwise indicated.
7. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
8. Products:
 - a. Continental Brick Company

2.5 MORTAR AND GROUT MATERIALS

- ### A. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- ### B. Mortar Cement: ASTM C 1329.

1. Available Products:
 - a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
 - b. Or equal.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
 1. Available Products:
 - a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
 - b. Davis Colors; True Tone Mortar Colors.
 - c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.
- D. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4-inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
- E. Aggregate for Grout: ASTM C 404.
- F. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- G. Cold-Weather Admixture: Non-chloride, non-corrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Available Products:
 - a. Addiment Incorporated; Mortar Kick.
 - b. Euclid Chemical Company (The); Accelguard 80.
 - c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
 - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
 - e. Approved equal.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
 1. Available Products:

- a. Addiment Incorporated; Mortar Tite.
- b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- c. Approved equal.

I. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry Joint Reinforcement, General: ASTM A 951 Building Code of New York 2103.11.2.
 1. Interior Walls: Hot-dip galvanized, carbon steel.
 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 3. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
 4. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
 5. Wire Size for Veneer Ties: W1.7 or 0.148-inch (3.8-mm) diameter.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 7. Provide in lengths of not less than 10 feet (3 m) with prefabricated corner and tee units.
- D. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
 1. Available Products:
 - a. Hohmann & Barnard, Inc. #220
 - b. Dur-o-wall #DA3200
 - c. Approved equal
- E. Masonry Joint Reinforcement for Multi-wythe Masonry:
 1. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement

perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

a. Available Products:

- 1) Hohmann & Barnard, Inc. #285 Ladder with 3/16" BYNA-Lock wire tie
- 2) Approved equal

- F. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- (4.8-mm-) diameter, stainless-steel continuous wire.

2.7 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
3. Stainless-Steel Sheet: ASTM A 666, Type 304.

- B. Corrugated Metal Ties: Not allowed anywhere.

- C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
2. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
3. Wire: Fabricate from 3/16-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.

- E. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire.

a. Available Products:

- 1) Hohmann & Barnard, Inc. #359-C (with back plate)
 - 2) Approved equal.
 2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire.
 - a. Available Products:
 - 1) Hohmann & Barnard, Inc. #301W (size as required)
 - 2) Approved equal
 3. Anchor Section for Anchoring across movement joints: (2) 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire with (2) hot-dip galvanized plates.
 - a. Available Products:
 - 1) Hohmann & Barnard, Inc. #Slip-Set Stabilizer Style "H"
 - 2) Approved equal
- F. Partition Top anchors: 0.097-inch- (2.5-mm-) thick metal plate with 3/8-inch- (10-mm-) diameter metal rod 6 inches (150 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
 1. Available Products:
 - a. Hohmann & Barnard, Inc. #PTA-420, NS-TA, & PTA tube.
 - b. Approved equal.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.4 mm) thick by 24 inches (600 mm) long, with ends turned up 2 inches (50 mm) or with cross pins, unless otherwise indicated.
 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M .
 - a. Available Products:
 - 1) Hohmann & Barnard, Inc. #344
 - 2) Approved equal
- H. Adjustable Masonry-Veneer Anchors
 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play more than 0.05 inch (1.3 mm).
 2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes top and bottom; top and bottom

- ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (150 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
- b. Anchor Section: Sheet metal plate, 14 gage, 1-1/4 inches (32 mm) wide by length required, 5/8-inch (16 mm) wide by 5-1/2 inches (140 mm) long, stamped into center to provide a slot between strap and plate for inserting sheet metal plate.
 - c. Wire Ties: Triangular-, rectangular-, 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.
 - d. Available Products:
 - 1) Hohmann & Barnard, Inc.; DW-10-X.
 - 2) Wire-Bond; 1004, Type III-X .
3. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.
- a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (75 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section. Size wire tie to extend at least 1-1/2 inches (38 mm) into veneer but with at least 5/8-inch (16-mm) cover on outside face.
 - b. Connector Section: Sheet metal clip welded to wire tie with integral tabs designed to engage continuous wire.
 - c. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (150 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
 - d. Connector Section: Triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Size wire tie to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face.
 - e. Available Products:
 - 1) Hohmann & Barnard, Inc.; DW-10-X-Seismicclip.
 - 2) Wire-Bond; RJ-711 with Wire-Bond clip.
4. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer,

No. 10 (4.8-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads.

- a. Available Products:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
 - 2) ITW Buildex; Scots long life Tek.
 - 3) Approved equal.

2.8 MISCELLANEOUS ANCHORS

- A. Special masonry anchors not specifically identified shall be provided as part of the work. Such anchors will be submitted to the architect for review prior to their use and shall meet the structural performance required.

2.9 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual " and as follows:
 - 1. Metal Drip Edges: Fabricate from stainless steel. Extend to inner width of wall and turn up 1 inch. Project drip edge 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed. Provide pre-fabricated corners free of sharp edges at all outside corner locations.
 - 2. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.
- B. Flexible Flashing, Thru-Wall Flashing: Use the following unless otherwise indicated:
 - 1. Stainless Steel Fabric: 304 stainless steel sheet bonded to polymeric fabric with adhesive backing. Use only where flashing is fully concealed in masonry.
 - a. Products:
 - 1) Hohmann & Barnard, Inc.; Mighty Flash SA.
 - 2) York Flashings; Multi-Flash SS.
 - 2. Termination Bar: At all horizontal terminations:
 - a. Rigid Thermoplastic extrusion by York Flashings; Termination Bar.
- C. Solder and Sealants for Sheet Metal Flashings:
 - 1. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, 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 D 2000, Designation M2AA-805 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, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Mortar/Grout screen: At locations where grout isolation is required. 1/4" square monofilament screen fabricated from high strength, non-corrosive polypropylene.
 1. Available Products:
 - a. Hohmann & Barnard, Inc. #MGS – Mortar / Grout Screen.
 - b. Approved equal.
- E. Weep/Vent Products: Use the following, unless otherwise indicated:
 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Products:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
 - 2) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - 3) Hohmann & Barnard, Inc.; Quadro-Vent.
 - 4) Wire-Bond; Cell Vent.
- F. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 1. Provide one of the following configurations:

- a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent mesh from being clogged with mortar droppings.
 2. Available Products:
 - a. Archovations, Inc.; CavClear Masonry Mat.
 - b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - c. Mortar Net USA, Ltd.; Mortar Net.
 - d. Approved equal.
 - G. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch (3.6-mm) steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
 1. Available Products:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
 - e. Approved equal.
 - H. Self-Sealing Penetration Tape: Adhesive backed tape for use under surface applied veneer anchors as an air and moisture barrier.
 1. Basis of Design: Hohmann & Barnard; X-Seal tape, or equal.
- 2.11 CAVITY-WALL INSULATION
- A. See Section 072100 Thermal Insulation.
- 2.12 MASONRY CLEANERS
- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

- d. Approved equal.

2.13 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. Limit cementitious materials in mortar to Portland cement and lime.
 - 3. Limit cementitious materials in mortar for exterior and reinforced masonry to Portland cement and lime.
 - 4. 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 C 270 BIA Technical Notes 8A, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of mason.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type N.
 - 3. For mortar parge coats, use Type N.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls, and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product [or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products].
 - 1. Pigments shall not exceed ten percent (10%) of Portland cement by weight.
 - 2. Mix to match Architect's sample.
- E. Grout for Unit Masonry: Comply with ASTM C 476
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.
- F. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

2.14 SOURCE QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
1. Payment for these services will be made by Owner.
 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

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 work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- 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 the 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.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, sizes and texture of existing masonry and mortar.
 - 1. Note: Bonding is different on the various additions. Note locations of the 'Flemish Bond' locations.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet (3 mm in 3 m), 1/4-inch in 20 feet (6 mm in 6 m), or 1/2-inch (12 mm) maximum.
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet (6 mm in 3 m), or 1/2-inch (12 mm) maximum.
 - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4-inch in 20 feet (6 mm in 6 m), or 1/2-inch (12 mm) maximum.
 - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
 - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
 - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
 - 1. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond ; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs. Note: Bonding is different on the various additions. Note locations of the 'Flemish Bond' indicated.
- B. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking 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.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- G. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- H. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c., unless otherwise indicated.

3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings and slabs..
- B. Lay solid masonry units (and hollow masonry 4" in width and less) with completely-filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- D. Tool joints flush for masonry walls to receive plaster. unless otherwise indicated.
- E. Rake top of horizontal joints and fill with sealant

3.5 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:
 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. (0.16 sq. m) of wall area spaced not to exceed 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
 - a. Where bed joints of wythes do not align or where the wythes are of different material, use adjustable (two-piece) type ties.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes .

- b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties].
- B. Bond wythes of composite masonry together using bonding system indicated on Drawings.
- C. Collar Joints: Solidly fill collar joints by paring face of first wythe that is laid and shoving units of other wythe into place.
- D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.
 - 1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores or tooth intersecting walls together

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. (0.16 sq. m) of wall area spaced not to exceed 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
 - 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.

- c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.
3. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- D. Coat cavity face of backup wythe to comply with Division 07 Section "Bituminous Dampproofing." or "Air barrier" where indicated.
- E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards,. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.8 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1 inch (25 mm) in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.9 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Embed tie sections and connector sections and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) (unless noted otherwise) of air space between back of masonry veneer and face of sheathing.
 - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 1.66 sq. ft. of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.

2. Install control joints where shown on plans. If a masonry span exceeds 30 feet horizontally and no control joint is shown, provide a control joint every 30 feet +/- where directed by architect.
3. Openings over 48" in width will have a control joint. Request location from architect if not shown on drawings.
4. Openings over 96" in width will have two control joints. Request location from architect if not shown on drawings.
5. Corners will have a control joint located within 24" of a corner. Request location from architect if not shown on drawings.

C. Form expansion joints in brick made from clay or shale as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 1/2 inch (13 mm) for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 1/2 inch (13 mm).

1. Locate horizontal, pressure-relieving joints beneath steel angles.

3.11 LINTELS

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

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows, unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place metal through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with

mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer. Form end dams at (1" minimum tapering up to full flashing height) all location where water has the potential of flowing off the sides of the flashing back into adjacent masonry, or masonry cavities.

2. At multi-wythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 12 inches (300mm), and 1-1/2 inches (38 mm) into the inner wythe. Form 1/4-inch (6-mm) hook in edge of flashing embedded in inner wythe.
 3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 12 inches (300mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm). Secure with continuous termination bar.
 4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
 5. Install stainless steel metal drip edges beneath fabric flashing at exterior face of wall. Stop fabric flashing 1/2 inch (13 mm) back from outside face of wall and adhere fabric flashing to top of metal drip edge in a full bed of butyl sealant.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing, at top of exterior wythes, and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Space weep holes 24 inches (600 mm) o.c., unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.13 REINFORCED UNIT MASONRY INSTALLATION

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

- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602 Building Code of New York chapter 21.
- 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 ACI 530.1/ASCE 6/TMS 602 Building Code of New York chapter 21 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 (1216mm).

3.14 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- G. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry 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 masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 - 7. Clean stone trim to comply with stone supplier's written instructions.

3.16 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.

2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section "Earth Moving."
 3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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SECTION 042613 - MASONRY VENEER

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Clay facing brick.
- B. Mortar.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Accessories.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.
- B. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
- C. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale) 2023.
- D. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.
- C. Samples: Submit four (4) samples of facing brick units to illustrate color, texture, and extremes of color range.

1.4 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.6 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 – PRODUCTS

2.1 BRICK UNITS

- A. Facing Brick:
 - 1. Color, size, and texture to match adjacent existing brick facades.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): As selected by Architect from manufacturer's full range.
- C. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

- A. Masonry Veneer Anchors: Two-piece anchors that permit differential movement between masonry veneer and structural backup, hot-dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Wire ties: Manufacturer's standard shape, 0.1875-inch-thick.
 - 2. Vertical adjustment: Not less than 3-1/2 inches.

2.4 FLASHINGS

- A. Metal Flashing Materials:
 - 1. Prefabricated Metal Flashing: Smooth-fabricated 12 oz/sq ft copper flashing for surface-mounted conditions.

2.5 ACCESSORIES

- A. Weeps:
 - 1. Type: Preformed aluminum vents with sloping louvers.
- B. Cavity Vents:
 - 1. Type: Polyester mesh.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.6 MORTAR MIXING

- A. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Units:
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.3 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing at bottom of walls.
- B. Install cavity vents in veneer walls at 32 inches on center horizontally below shelf angles and lintels and at top of walls.

3.4 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Concrete Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels.

3.5 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

3.6 CLEANING

- A. Clean soiled surfaces with cleaning solution.

3.7 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 042613

SECTION 045020 – COLD (HOT) WEATHER MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work of this Section includes all labor, materials, equipment and services necessary to complete the work of cold/hot weather masonry as shown on the Drawings, as specified herein, and as may be required by conditions and authorities having jurisdiction, including, but not limited to, work necessary to comply with special requirements for undertaking masonry work specified in other sections when temperatures are below 40 deg F.

1.3 QUALITY ASSURANCE

- A. General: Comply with requirements of Brick Industry Association (BIA), Technical Notes 1, Cold and Hot Weather Construction 2006, or as most recently updated; requirements specified in this Section; and requirements specified in individual sections requiring masonry work. In case of conflict, the strictest and most restrictive requirements shall govern.
- B. Prior Approval: Do not proceed with masonry work in cold/hot weather unless Architect has specifically approved in writing:
 - 1. Contractor's Work Proposal for cold/hot weather masonry.
 - 2. Specific masonry work to be undertaken in each case.
- C. Prohibited Materials: Do not add unapproved substances to mortars or grouts.
- D. Laws, Code and Regulations: Work of this Section shall comply with all applicable federal, state, and local laws, codes and regulations.

1.4 ACTION SUBMITTALS

- A. 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 material Safety Data sheets (MSDS).

- B. Work proposal for Col/Hot Weather Masonry: Proposal for executing masonry work as specified in other sections during cold/hot weather. Include proposed materials, equipment methods and procedures to ensure that cold/hot weather masonry work complies with requirements of this Section.

1.5 PROJECT CONDITIONS

- A. Protection of Building: Protect building elements, materials and finishes from damage and from deterioration caused by or resulting from work of this Section. Repair damage to materials and damage to finishes caused by or resulting from cold/hot weather masonry work to Restoration Consultant's satisfaction at no additional cost.
- B. Protection from Fire: Take all necessary precautions to prevent fire and spread of fire.
 - 1. Covers: membranes, insulation blankets and other materials used to cover masonry shall be flame retardant and fire resistant.
 - 2. Warming Devices: Heating blankets, infrared heaters and other warming devices shall be UL approved and inspected for damage before use.
 - 3. Open Flame Heaters: No open flame heaters shall be used to protect finished masonry. Heaters used to warm water or sand for mortar or grout shall be well away from building and from flammable substances.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Covers: Install membrane covers, insulation blankets and other protection to avoid damaging masonry. Do not drill holes in masonry or in any other way damage masonry.
- B. Misting equipment.

3.2 COLD WEATHER CONSTRUCTION

- A. General: Cold weather masonry work using cementitious mortars shall adhere to following requirements for work, performed in ambient temperatures indicated, as well

as all published guidelines in Brick Industry Association (BIA), Technical Notes I, Cold and Hot Weather Construction 2006, as updated. In case of conflict, most stringent requirements shall govern. Work shall not be permitted in freezing weather, or when temperature of air or wall is at or below freezing or expected to go below freezing within 48 hours of work without Architect's prior written approval. No work shall begin when any part of wall or materials in use are frozen or subject to freezing temperatures.

- B. Observe restoration mortar guidelines.
- C. Temperature Range 40 deg F to 32 deg F: Heat mixing water or sand to produce mortar between 40 deg F and 120 deg F and maintain above 40 deg F until placed at that temperature.
- D. Temperature Range 32 deg F to 20 deg F:
 - 1. Heat mixing water and sand to produce mortar between 40 deg F and 120 deg F. Heat grout materials so grout is maintained and placed at a temperature between 40 deg F and 120 deg F. Maintain mortar and grout above freezing until used in masonry.
 - 2. For work between 25 deg and 20 deg F, heat and maintain masonry units above 40 deg F if grouting.
- E. Temperature 20 deg F and Below: Heat mixing water and sand to produce mortar between 40 deg F and 120 deg F. Heat grout materials so grout is placed at a temperature between 40 deg F and 120 deg F. Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F. Provide enclosure to heat and maintain temperatures above freezing within enclosure.

3.3 HOT WEATHER CONSTRUCTION

- A. General: Hot weather masonry work using cementitious mortars shall adhere to following requirements for work, performed in ambient temperatures indicated, as well as all published guidelines in Brick Industry Association (BIA), Technical Notes I, Cold and Hot Weather Construction 2006, as updated. In case of conflict, most stringent requirements shall govern. Work shall not be permitted in extreme hot weather, when the ambient air temperature reaches 100 deg F or 90 Deg F with a wind velocity greater than 8 mph without Architect's prior written approval. Keep materials cool during periods of hot weather.
- B. Provide wet curing or fog misting if temperatures reach extremes noted in paragraph A. Keep equipment cool by flushing with cool before contact with mortar or mortar materials. Shade equipment and materials from direct sunlight. Use wind breaks to prevent rapid drying of mortar during and after placement. Cover walls with weather

resistant membrane at end of work day to prevent rapid loss of moisture from assemblies.

3.4 ADDITIONAL PROTECTION OF COMPLETED MASONRY WORK IN COLD WEATHER

- A. General: Protect completed masonry work in the following manner. Temperature ranges indicated apply to anticipated minimum night temperatures.
- B. Temperature range 40 deg F to 32 deg F: Protect masonry from rain or snow for at least twenty-four (24) hours by covering with weather-resistive membrane.
- C. Temperature range 32 deg F to 20 de F: Completely cover masonry with weather-resistive insulating blankets or similar protection for at least twenty-four (24) hours, forty-eight (48) hours for grouted masonry.
- D. Temperature 20 deg F and Below: Except as otherwise indicated, maintain masonry temperature above 32 deg F for twenty-four (24) hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods prevent to be satisfactory. For grouted masonry maintain heated enclosure to 40 deg F for forty-eight (48) hours.

3.5 WASTE MANAGEMENT

- A. Coordinate with Division 01.
 - 1. Separate and recycle cut-offs and waste materials and material packaging in accordance with Waste Management Plan and to the maximum extent economically feasible and place in designated areas for recycling.
 - 2. Set aside and protect materials suitable for reuse and/or remanufacturing.
 - 3. Separate and fold up metal banding; flatten and place along with other metal scrap for recycling in designated area.

END OF SECTION 045020

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Load-bearing wall framing.
 - 2. Ceiling joist framing.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Qualification Data: For testing agency.
- D. Product Certificates: For each type of code-compliance certification for studs and tracks.

- E. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Mechanical fasteners.
 - 4. Vertical deflection clips.
 - 5. Miscellaneous structural clips and accessories.
- F. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design:
 - 1. MarinoWare, JoistRite.
 - 2. MarinoWare, StudRite.

2.2 PERFORMANCE REQUIREMENTS

- A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 - 1. Floor and Roof Systems: AISI S210.
 - 2. Wall Studs: AISI S211.
 - 3. Headers: AISI S212.
 - 4. Lateral Design: AISI S213.

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

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 - 1. Grade: ST50H.
 - 2. Coating: G60, A60, AZ50, or GF30.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1.
 - 2. Coating: G60.

2.4 LOAD-BEARING WALL FRAMING

- A. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0966 inch.
 - 2. Flange Width: 1-5/8 inches.

2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0451 inch.
 - 2. Flange Width: 2 inches, minimum.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Anchor clips.
4. End clips.
5. Joist hangers and end closures.
6. Hole-reinforcing plates.
7. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC193 ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
 1. Uses: Securing cold-formed steel framing to structure.
 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
- C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Non-metallic, Non-shrink Grout: Factory-packaged, non-metallic, non-corrosive, non-staining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multi-monomer, non-leaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4-inch-thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three (3) exposed screw threads.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8-inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8-inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8-inch.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 JOIST INSTALLATION

- A. Install joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
- C. Space joists not more than two (2) inches from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

- E. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.4 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8-inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Loose Lintels: Installed under Section 042000 or 042113 and 042200.

1.2 REFERENCES

- A. Except as shown or specified otherwise, the Work of this Section shall meet the requirements of the following:
 - 1. Design, Fabrication, and Erection: "Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design" adopted by the American Institute of Steel Construction, June 1, 1989 (AISC Specification).
 - a. Design and Fabrication of Cold-Formed Shapes: "Specification for the Design of Cold-Formed Steel Structural Members", by the American Iron and Steel Institute (AISI Specification).
 - 2. Welding: "Structural Welding Code - Steel, AWS D1.1", or "Structural Welding Code - Sheet Steel, AWS D1.3", by the American Welding Society (AWS Codes).
- B. Organizations:
 - 1. AISC: American Institute of Steel Construction, One East Wacker Dr., Suite 700, Chicago, IL 60601-1802, 866-275-2472, www.aisc.org.
 - 2. AISI: American Iron and Steel Institute, 1140 Connecticut Ave., NW, Suite 705, Washington, D.C. 20036, (202) 452-7100, www.steel.org.
 - 3. AWS: American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126, (800) 443-9353, www.aws.org.
 - 4. ANSI: American National Standards Institute, 1819 L Street, NW, 6th Floor, Washington, DC 20036, (202) 293-8020, www.ansi.org.
 - 5. ASTM: ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA, 19428-2959, (610) 832-9500, www.astm.org.
 - 6. SSPC: The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh PA 15222-4656, (877) 281-7772, www.sspc.org.

1.3 SUBMITTALS

- A. Shop Drawings: Show application to project. Furnish setting drawings and templates for installation of bolts and anchors in other Work. Indicate shop and field welds by standard AWS welding symbols in accordance with AWS A2.4.
- B. Product Data: Catalog sheets, specifications, and installation instructions for each fabricated item specified, except submit data for fasteners only when directed.
- C. Quality Control Submittals:

1. Certificates: Copy of certificates required under Quality Assurance Article.

1.4 QUALITY ASSURANCE

A. Certificates:

1. Affidavit by the structural steel manufacturer certifying that structural steel items meet the contract requirements.
 - a. Submit evidence of steel material compliance with this Specification. Evidence shall consist of certification of source of material, copies of purchase orders and manufacturer's certifications. For stock material, submit copies of latest mill or purchase orders for material replacement.

- ##### B. Galvanizing: Stamp galvanized items with galvanizer's name, weight of coating, and applicable ASTM number.

1.5 DELIVERY AND STORAGE

- ##### A. Coordinate delivery of items to be built into other construction to avoid delay.
- ##### B. Promptly cover and protect steel items delivered to the Site.

PART 2 - PRODUCTS

2.1 MATERIALS

- ##### A. Steel Plates: ASTM A 36, except as specified or shown otherwise.
- ##### B. Angles: ASTM A 36 or ASTM A 572, Grade 50.
- ##### C. Anchors: Except where shown or specified, select anchors of type, size, style, grade, and class required for secure installation of metal fabrications. For exterior use and where built into exterior walls, anchors shall be galvanized or of corrosive-resistant materials.
1. Wedge-Type Concrete Inserts: Galvanized box-type ferrous casting, designed to accept 3/4-inch diameter bolt having special wedge-shaped head; either malleable iron or cast steel.
 - a. Bolts: Carbon steel bolts having special wedge-shaped heads, nuts, washers and shims.
- ##### D. Fasteners: Except where shown or specified, select fasteners of type, size, style, grade, and class required for secure installation of metal fabrications. For exterior use and where built into exterior walls, fasteners shall be galvanized.
1. Standard Bolts and Nuts: ASTM A 307, Grade A, regular hexagon head.
 2. Machine Screws: ASME B18.6.3.
 3. Plain Washers: Round, ASME B18.22.1.
 4. Lock Washers: Helical, spring type, ASME B18.21.1.

- E. Shop Paint (General): Universal shop primer; fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Shop Paint for Galvanized Steel: Epoxy zinc-rich primer; complying with MPI#20 and compatible with topcoat.
- G. Bedding Mortar:
 - 1. Shrink-Resistant Grout (Non-Staining): Factory-packaged, non-ferrous mortar grouting compound selected from the following:
 - a. Masterflow 713 by Master Builders, 23700 Chagrin Blvd., Cleveland, OH 44122 (800) 227-3350.
 - b. SonogROUT by Sonneborn, Chemrex, Inc., 57-46 Flushing Ave., Maspeth, NY 11378, (800) 433-9517.
 - c. Five Star Grout by Five Star Products, Inc., 425 Stillson Rd., Fairfield, CT 06430, (800) 243-2206.
 - d. Crystex by L&M Construction Chemicals, 14851 Calhoun Rd., Omaha, NB 68152, (800) 362-3331.
 - e. Non-Corrosive, Non-Shrink Grout by A.C. Horn, Inc., Tamm Industries, 7405 Production Dr., Mentor, OH 44060, (800) 862-2667.

2.2 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Fabricate metal framing and supports to support related items required by the Work. Fabricate of welded construction unless otherwise indicated. Preassemble to largest extent possible.
- B. When required to be built into other Work, equip units with integral anchors spaced not more than 24 inches on center.
- C. Galvanize exterior steel framing and supports.

2.3 LOOSE LINTELS

- A. Structural steel shape lintels, fabricated for openings and recesses in masonry walls and partitions as indicated. Loose lintels bearing on masonry or concrete shall have a minimum end bearing length of 6 inches at each end, unless otherwise shown.
- B. Galvanize lintels to be installed in exterior walls.

2.4 FABRICATION

- A. Use materials of size and thickness indicated. If not indicated, use material of required size and thickness to produce adequate strength and durability for the

intended use of the finished product. Furnish suitable, compatible anchors and fasteners to support assembly.

- B. Fabricate items to be exposed to view of material entirely free of surface blemish, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove surface blemishes by grinding or by welding and grinding prior to cleaning, treating, and finishing. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown.
- C. Joints: Fabricate accurately for close fit. Weld exposed joints continuously unless otherwise indicated or approved. Dress exposed welds flush and smooth.
- D. Connections: Form exposed connections with flush, smooth, hairline joints. Use concealed fasteners wherever possible. Use Phillips flathead (countersunk) bolts or screws for exposed fasteners, unless otherwise shown or specified.
 - 1. Furnish flat washer under connections requiring raised bolt heads.
 - 2. Furnish lock washer under nuts when through-bolting occurs.
- E. Punch, reinforce, drill, and tap metal Work as required to receive hardware and other appurtenant items.
- F. Galvanizing:
 - 1. In addition to specific items specified or noted to be galvanized, galvanize items attached to, embedded in, or supporting exterior masonry (including interior wythe of exterior masonry walls) and concrete Work.
 - 2. Unless otherwise specified or noted, items indicated to be galvanized shall receive a zinc coating by the hot-dip process, after fabrication, complying with the following:
 - a. ASTM A 123 for plain and fabricated material, and assembled products.
 - b. ASTM A 153 for iron and steel hardware.
- G. Shop Painting:
 - 1. Cleaning Steel: Thoroughly clean all steel surfaces. Remove oil, grease, and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning". Remove loose mill scale, loose rust, weld slag and spatter, and other detrimental material in accordance with SSPC SP-2 "Hand Tool Cleaning", SSPC SP-3 "Power Tool Cleaning", or SSPC SP-7 "Brush-Off Blast Cleaning".
 - 2. Galvanized Items:
 - a. Galvanized items which are to be finish-painted under Section 099101 shall be rinsed in hot alkali or in an acid solution and then in clear water.
 - b. Welded and abraded areas of galvanized surfaces shall be wire brushed and repaired with a coating of cold galvanizing compound.
 - 3. Apply one (1) coat of shop paint to all steel surfaces except as follows:
 - a. Do not shop paint steel surfaces to be field welded and steel to be encased in cast-in-place concrete.

- b. Apply two (2) coats of shop paint, before assembly, to steel surfaces inaccessible after assembly or erection, except surfaces in contact.
 - c. Do not paint galvanized items which are not to be finished painted under Section 099101.
- 4. Apply paint and compound on dry surfaces in accordance with the manufacturer's printed instructions, and to the following minimum thickness per coat:
 - a. Shop Paint (General): 4.0 mils wet film.
 - b. Shop Paint for Galvanized Steel: 3.0 mils wet film.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Temporarily brace and secure items which are to be built into concrete, masonry, or similar construction.
- B. Isolate non-ferrous metal surfaces to be permanently fastened in contact with ferrous metal surfaces, concrete, or masonry by coating non-ferrous metal surface with bituminous mastic, prior to installation.

3.2 INSTALLATION

- A. Fit and set fabricated metal Work accurately in location, alignment, and elevation. Securely fasten in place. Cut off exposed threaded portion of bolts flush with nut.
- B. Set loose items on cleaned bearing surfaces, using wedges or other adjustments as required. Solidly pack open spaces with bedding mortar or grout.
- C. Attached Work: Fasten to concrete and solid masonry with expansion anchors and to hollow masonry with toggle bolts in cells, unless otherwise indicated. Drill holes for fasteners to exact required size using power tools.

END OF SECTION 055000

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- C. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2023.
- G. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.
- H. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube 2022.

- I. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube 2020.
- J. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- D. Designer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

PART 2 – PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set.
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
 - 1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
 - 2. Intermediate Rails: 1-1/2 inches diameter, round.
 - 3. Posts: 1-1/2 inches diameter, round.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

2.2 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: No exposed bolts or screws.
- E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic.

2.3 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.

- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055213

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SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Rooftop equipment bases and support curbs.
 - 3. Wood blocking and nailers.
 - 4. Wood furring and grounds.
 - 5. Wood sleepers.
 - 6. Utility shelving.
 - 7. Plywood backing panels for electric, phone, technology, and mechanical panels.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. NLGA: National Lumber Grades Authority.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
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.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Steel Source: All steel specified in the Section shall be produced or made in North America, for the following items:

1. All types of Bolts.
2. All types of Anchors.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. 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 lumber.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- D. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- E. Application: Treat items indicated on Drawings, and the following:

1. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Sleepers.
 5. Utility shelving.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber and any of the following species:
 1. Hem-fir (north); NLGA.
 2. Spruce-pine-fir; NLGA.
 3. Hem-fir; WCLIB or WWPA.
- C. For utility shelving, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Hem-fir or hem-fir (north), Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
- D. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 1. Hem-fir or hem-fir (north), Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
 2. Spruce-pine-fir (south) or spruce-pine-fir, Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.7 METAL FRAMING ANCHORS

- 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. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preserved-treated lumber and where indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Use for exterior locations and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) on center.
- H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

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

END OF SECTION 061053

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SECTION 061600 - SHEATHING

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. Sheathing.
 - 2. Sheathing joint and penetration treatment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory".

2.2 WOOD PANEL PRODUCTS

- A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.4 SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Nominal Thickness: Not less than 1/2 inch (13 mm).
- B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation: GlasRoc.
 - b. Georgia-Pacific Building Products: Dens-Glass Gold.
 - c. National Gypsum Company: Gold Bond eXP Extended Exposure Sheathing.
 - d. United States Gypsum Company: Securock.
 - 2. Type and Thickness: Regular, 1/2-inch (13 mm) and Type X, 5/8-inch (15.9 mm) (for fire treated conditions) thick.
 - 3. Size: Minimum 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 2. For roof sheathing, provide fasteners per roofing system requirements.
- B. Power-Driven Fasteners: NES NER-272.
- C. Wood Screws: ASME B18.6.1.
- D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing

to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels **1/8-inch (3 mm)** apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install boards with a **3/8-inch (9.5-mm)** gap where non-load-bearing construction abuts structural elements.
 - 4. Install boards with a **1/4-inch (6.4-mm)** gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately **8 inches (200 mm)** o.c. and set back a minimum of **3/8-inch (9.5 mm)** from edges and ends of boards.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8-inch (9.5 mm) from edges and ends of boards.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior standing and running trim.
 - 2. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
 - 3. Shop priming of interior architectural woodwork.
 - 4. Shop finishing of interior architectural woodwork.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Wood-Preservative Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

2. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 3. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Shop Drawings: For interior architectural woodwork.
1. Include plans, elevations, sections, and attachment details.
 2. Show large-scale details.
 3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
 4. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For the following:
1. Lumber for Transparent Finish: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
 2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.
 3. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches (125 mm) wide by 12 inches (300 mm) long for lumber and [8 by 10 inches (200 by 250 mm)] [12 by 12 inches (300 by 300 mm)] for panels, for each finish system and color.
 - a. Finish entire exposed surface.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Fabricator.
- B. Product Certificates: For the following:
1. Composite wood and agrifiber products.
 2. Adhesives.
- C. Evaluation Reports: For fire-retardant-treated wood materials, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical interior architectural woodwork as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

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

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Wood Species and Cut: See below.
 - 1. Species: White oak.
 - 2. Cut: Plain sliced/plain sawn.
 - 3. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
 - 1. For veneered base, use hardwood lumber core, glued for width.
- D. For base wider than available lumber, glue for width. Do not use veneered construction.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
 - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
 - 2. Wood Moisture Content: 5 to 10 percent.

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

- 1. MDF: ANSI A208.2, Grade 130.
- 2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.4 PRESERVATIVE-TREATED-WOOD MATERIALS

- A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

- 1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with a compatible EPA-registered insecticide.
- 2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.6 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Edges of Solid-Wood (Lumber) Members: 1/16-inch (1.5 mm) unless otherwise indicated.

2. Edges of Rails and Similar Members more than 3/4-inch (19 mm) thick: 1/8-inch (3 mm).
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
1. Notify Architect seven (7) days in advance of the dates and times interior architectural woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that parts fit as intended and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.7 SHOP PRIMING

- A. Interior Architectural Woodwork for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099100 "Painting."
- B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

2.8 SHOP FINISHING

- A. General: Finish interior architectural woodwork [with transparent finish] [indicated on Drawings] at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
1. Backpriming: Apply one (1) coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish:
1. Grade: Premium.
 2. Finish: System - 11, catalyzed polyurethane.

3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: Match existing finish of interior wood, based on Architect's approval.
5. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.
- F. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

- G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk, and filled flush with interior architectural woodwork.
 - 1. For shop-finished items, use filler matching finish of items being installed.
- H. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long except where shorter single-length pieces are necessary.
 - 1. Scarf running joints and stagger in adjacent and related members.
 - 2. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
 - 3. Install standing and running trim with no more variation from a straight line than 1/8-inch in 96 inches (3 mm in 2400 mm).
- I. Touch up finishing work specified in this Section after installation of interior architectural woodwork. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.
- J. See Section 099100 "Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects. Where not possible to repair, replace interior architectural woodwork. Adjust joinery for uniform appearance.
- B. Clean interior architectural woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Plastic sheet paneling within Custodial Closets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling, in manufacturer's standard sizes.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

1. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
2. Nominal Thickness: Not less than 0.075 inch (1.9 mm).
3. Surface Finish: Molded pebble texture.
4. Color: White.

2.3 ACCESSORIES

- A. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- B. Adhesive: As recommended by plastic paneling manufacturer.
- C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, 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. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.

- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
 - 1. Drill oversized fastener holes in panels and center fasteners in holes.
 - 2. Apply sealant to fastener holes before installing fasteners.
- D. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.
 - 3. Mineral-wool blanket.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Low-emitting product certification.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

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

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Owens Corning; Foamular High R CW Plus.
 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- C. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 25-psi (173-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Owens Corning; Foamular 250.
 2. Location of Use: Below grade foundation wall, under slab.
 - a. R-Value/thickness: R=10, 2-inch thickness.
 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 GLASS-FIBER BLANKET

- A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 1. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

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 Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Owens Corning.
- C. Glass-Fiber Blanket, Foil Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
 1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; CertaPro Commercial Insulation or equal.
 2. 3-1/2 Inch = R-13.
 3. 6-1/4 inch = R-19.

2.3 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 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. Industrial Insulation Group, LLC (IIG-LLC).
 - b. Roxul Inc.
 - c. Thermafiber, Inc.; an Owens Corning company.

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate-welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. AGM Industries, Inc; Series T TACTOO Insul-Hangers.
 - b. Gemco; Spindle Type.
 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030-inch (0.762 mm) thick by 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

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

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

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

3.6 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is

subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072600 – VAPOR RETARDERS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Reinforced vapor retarders.
- B. Tape to seal joints and repair vapor retarder.
- C. Pipe boots for sealing penetrations.

1.2 RELATED SECTIONS

- A. Section 033001 Cast-in-Place Concrete.
- B. Section 054000 Cold-Formed Metal Framing.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D 882 - Tensile Properties of Thin Plastic Sheeting.
 - 2. ASTM D 1709 - Impact Resistance of Plastic Film by the Free-Falling Dart Method.
 - 3. ASTM D 2582 - Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
 - 4. ASTM D 3776 - Mass Per Unit Area (Weight) of Woven Fabric.
 - 5. ASTM D 4833 - Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
 - 6. ASTM E 84 - Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 8. ASTM E 1643 - Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - 9. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- B. National Fire Protection Association (NFPA): NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000 Administrative Requirements.
- B. Product Data: 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.
- C. Samples: Submit manufacturer's samples of reinforced vapor retarders.
- D. Verification Samples: For each product specified, two samples, minimum size 5 inches (125 mm) square, representing actual product.

1.5 QUALITY ASSURANCE

- A. Preinstallation Meeting: Convene a preinstallation meeting two weeks before start of installation of reinforced vapor retarders. Require attendance of parties directly affecting work of this section, including Contractor, Architect, and installer. Review installation, protection, and coordination with other work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage:
 - 1. Store products in manufacturer's unopened packaging until ready for installation.
 - 2. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturer: Griffolyn, Division of Reef Industries, Inc., which is located at: 9209 Alameda Genoa Rd.; Houston, TX 77075; Toll Free Tel: 800-231-6074; Tel: 713-507-4251; Fax: 713-507-4295; Email: [request info \(ri@reefindustries.com\)](mailto:requestinfo@reefindustries.com); Web: <https://www.reefindustries.com>
- B. Requests for substitutions will be considered in accordance with provisions of Section 016000 Product Requirements.

2.2 REINFORCED VAPOR RETARDERS

- A. Reinforced Vapor Retarder: Griffolyn Type-65 G for use under concrete slabs; complying with ASTM E 1745 Class A.
 - 1. Material: 4-ply laminate, combining 2 layers of high-density polyethylene and a high-strength non-woven cord grid with a layer of non-woven geotextile fiber.
 - 2. Weight: 73 lb/1,000 sq ft (35.7 kg/100 sq m), when tested in accordance with ASTM D 3776.
 - 3. Puncture Propagation Tear: 55 lb (245 N), when tested in accordance with ASTM D 2582.
 - 4. Permeance (Perm): 0.038 grains/hr-sq ft-in Hg (2.18 ng/(Pa-s-sq m)), when tested in accordance with ASTM E 96.
 - 5. Drop Dart: 2300 g, when tested in accordance with ASTM D 1709.
 - 6. Tensile Strength: 160 lb/1,350psi (710 N/9.3 MPa), when tested in accordance with ASTM D 882, 3 inch (76 mm) wide specimen.
 - 7. Puncture Strength: 60 lb (265 N), when tested in accordance with ASTM D 4833.
 - 8. Classification: Class A, when tested in accordance with ASTM E 1745.
 - 9. Usable Temperature Range: Minus 25 to 170 degrees F (minus 32 to 77 degrees C).
 - 10. Application: Use under concrete slabs, over aggregate fill.
 - 11. Application: Use under concrete slabs, under aggregate fill.
- B. Reinforced Vapor Retarder: Griffolyn Vaporguard; complying with ASTM E 1745 Class B.
 - 1. Material: 3-ply laminate, with an aluminum core surrounded by two layers of multi-axially oriented, high-density polyethylene.
 - 2. Weight: 84 lb/1,000 sq ft (41 kg/100 sq m), when tested in accordance with ASTM D 3776.
 - 3. Puncture Propagation Tear: 42 lb (178 N), when tested in accordance with ASTM D 2582.
 - 4. Permeance (Perm): 0.000 grains/hr-sq ft-in Hg (0.000 ng/(Pa-s-sq m)), when tested in accordance with ASTM E 96.

5. Drop Dart: 1750 g, when tested in accordance with ASTM D 1709.
 6. Tensile Strength: 105 lb/2,200 psi (467 N/15.16 MPa), when tested in accordance with ASTM D 882, 3 inch (76 mm) wide specimen.
 7. Puncture Strength: 45 lb (200 N) , when tested in accordance with ASTM D 4833.
 8. Usable Temperature Range: Minus 40 to 170 degrees F (minus 40 to 77 degrees C).
 9. Application(s):
 - a. Use on roof decks under insulation.
 - b. Use on exterior walls on inside face of framing.
 - c. Use under concrete slabs, over aggregate fill.
- C. Reinforced Vapor Retarder: Griffolyn Type-105; complying with ASTM E 1745 Class A.
1. Material: 7-ply laminate, combining four layers of high-density polyethylene and three high-strength non-woven cord grids.
 2. Weight: 91 lb/1,000 sq ft (44.4kg/100 sq m), when tested in accordance with ASTM D 3776.
 3. Puncture Propagation Tear: 55 lb (245 N), when tested in accordance with ASTM D 2582.
 4. Permeance (Perm): 0.019 grains/hr-sq ft-in Hg (1.207 ng/(Pa-s-sq m)) when tested in accordance with ASTM E 96.
 5. Drop Dart: 2,300 g, when tested in accordance with ASTM D 1709.
 6. Tensile Strength: 275 lb/5,464 psi (1,223 N/37.7 MPa), when tested in accordance with ASTM D 882, 3 inch (76 mm) wide specimen.
 7. Puncture Strength: 79 lb (350 N), when tested in accordance with ASTM D 4833.
 8. Usable Temperature Range: Minus 45 to 170 degrees F (minus 42 to 77 degrees C).
 9. Application(s):
 - a. Use on roof decks under insulation.
 - b. Use on exterior walls on inside face of framing.
 - c. Use under concrete slabs, over aggregate fill.
 - d. Use under concrete slabs, under aggregate fill.
- D. Reinforced Vapor Retarder: Griffolyn Type-85; complying with ASTM E 1745 Class B.
1. Material: 5-ply laminate, combining three layers of high-density polyethylene and two high-strength non-woven cord grids.
 2. Weight: 70 lb/1,000 sq ft (34.2 kg/100 sq m), when tested in accordance with ASTM D 3776.
 3. Puncture Propagation Tear: 55 lb (245 N), when tested in accordance

- with ASTM D 2582.
4. Permeance (Perm): 0.027 grains/hr-sq ft-in Hg (1.551 ng/(Pa-s-sq m)), when tested in accordance with ASTM E 96.
 5. Drop Dart: 1,900 g, when tested in accordance with ASTM D 1709.
 6. Tensile Strength: 225 lb/3,846 psi (1000 N/26.6 MPa), when tested in accordance ASTM D 882, 3 inch (76 mm) wide specimen.
 7. Puncture Strength: 50 lb (222 N), when tested in accordance with ASTM D 4833.
 8. Usable Temperature Range: Minus 40 to 170 degrees F (minus 40 to 77 degrees C).
 9. Application(s):
 - a. Use on roof decks under insulation.
 - b. Use on exterior walls on inside face of framing.
 - c. Use under concrete slabs, over aggregate fill.
 - d. Use under concrete slabs, under aggregate fill.
- E. Reinforced Vapor Retarder: Griffolyn Type-65; complying with ASTM E 1745 Class C.
1. Material: 3-ply laminate, combining two layers of high-density polyethylene and one high-strength non-woven cord grid.
 2. Weight: 40 lb/1,000 sq ft (19.5 kg/100 sq m, when tested in accordance with ASTM D 3776.
 3. Puncture Propagation Tear: 30 lb (133 N), when tested in accordance with ASTM D 2582.
 4. Permeance (Perm): 0.038 grains/hr-sq ft-in Hg (2.18 ng/(Pa-s-sq m)), when tested in accordance with ASTM E 96.
 5. Drop Dart: 475 g, when tested in accordance with ASTM D 1709.
 6. Tensile Strength: 100 lb/4560 psi (444 N/31.5 MPa), when tested in accordance with ASTM D 882, 3 inch (76 mm) long test specimen.
 7. Puncture Strength: 35 lb (155 N), when tested in accordance with ASTM D 4833.
 8. Usable Temperature Range: Minus 25 to 170 degrees F (minus 32 to 77 degrees C).
 9. Application(s):
 - a. Use on roof decks under insulation.
 - b. Use on exterior walls on inside face of framing.
 - c. Use under concrete slabs, over aggregate fill.
 - d. Use under concrete slabs, under aggregate fill.
- F. Vapor Retarder: Griffolyn 10 Mil Green; complying with ASTM E 1745 Class A.
1. Material: Extruded polyethylene film
 2. Weight: 49 lbs/1,000 sq ft (23.9 kg/100 sq m), when tested in

- accordance with ASTM D 3776.
3. Puncture Propagation Tear: 34 lb (150 N), when tested in accordance with ASTM D 2582.
 4. Permeance (Perm): 0.027 grains/hr-sq ft-in Hg (1.549 ng/(Pa-s-sq m)), when tested in accordance with ASTM E 96.
 5. Drop Dart: 2270 g, when tested in accordance with ASTM D 1709.
 6. Tensile Strength (1" Tensile) : 44 lb/4400 psi (195 N/30.3 MPa), when tested in accordance with ASTM D 882, .
 7. Puncture Strength: 24 lb (107 N), when tested in accordance with ASTM D 4833.
 8. Usable Temperature Range: Minus 25 to 170 degrees F (minus 32 to 77 degrees C).
 9. Application(s):
 - a. Use on roof decks under insulation.
 - b. Use on exterior walls on inside face of framing.
 - c. Use under concrete slabs, over aggregate fill.
 - d. Use under concrete slabs, under aggregate fill.
- G. Vapor Retarder: Griffolyn 15 Mil Green; complying with ASTM E 1745 Class A.
1. Material: Extruded polyethylene Film
 2. Weight: 73 lb/1,000 sq ft (35.6 kg/100 sq m, when tested in accordance with ASTM D 3776.
 3. Puncture Propagation Tear: 46 lb (204 N), when tested in accordance with ASTM D 2582.
 4. Permeance (Perm): 0.018 grains/hr-sq ft-in Hg (1.032 ng/(Pa-s-sq m)), when tested in accordance with ASTM E 96.
 5. Drop Dart: 3150 g, when tested in accordance with ASTM D 1709.
 6. Tensile Strength (1" Tensile): 72 lb/4800 psi (320 N/33.100 MPa), when tested in accordance with ASTM D 882.
 7. Puncture Strength: 24 lb (107 N), when tested in accordance with ASTM D 4833.
 8. Usable Temperature Range: Minus 25 to 170 degrees F (minus 32 to 77 degrees C).
 9. Application(s):
 - a. Use on roof decks under insulation.
 - b. Use on exterior walls on inside face of framing.
 - c. Use under concrete slabs, over aggregate fill.
 - d. Use under concrete slabs, under aggregate fill.

2.3 ACCESSORIES

- A. General: Ensure accessories are from same manufacturer as reinforced

vapor retarders.

- B. Mastic Tape: Griffolyn Fab Tape. RI Part Number: 60-0002.
 - 1. Description: Black, double-sided, asphaltic, pressure-sensitive, mastic tape.
 - 2. Weight: 3.75 pounds per 100 feet (1.7 kg per 30 m).
 - 3. Thickness: 35 mils (0.9 mm).
 - 4. 3 Inch Seam Shear: 35 pounds (156N).
- C. Self-Adhesive Repair Tape: Griffolyn Sealant Tape RI Part Number: 60-0153.
 - 1. Description: Reinforced white backing with Gray Adhesive.
 - 2. Weight: 3.0 lbs for 4 inch x 50 foot roll.
 - 3. Thickness: 26 mils (0.65 mm).
 - 4. 3 inch Seam Shear: 30 lbs (134 N)
- D. Fire Retardant Self-Adhesive Tape: Griff Tape FR RI Part Number 60-0151.
 - 1. Description: White backed adhesive tape.
 - 2. Weight: 3.75 lbs per roll, 4 inches x 180 feet long.
 - 3. Thickness: 5 mils(0.125 mm).
 - 4. Adhesion to Steel: 66 oz/in (18 N/in).
- E. Pipe Boots: Griffolyn pipe boots, factory-fabricated.
- F. Batten Strips: Manufacturer's standard for required application.
- G. Fasteners: Manufacturer's standard for required application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas to receive reinforced vapor retarders. Notify Architect in writing of defects of work and other unsatisfactory site conditions that would cause defective installation of vapor retarders. Do not begin installation until unacceptable conditions have been corrected.
- B. Verify site dimensions.
- C. Commencement of work will imply acceptance of substrate.

3.2 INSTALLATION

- A. Install reinforced vapor retarders in accordance with manufacturer's instructions.
- B. Install reinforced vapor retarders in accordance with manufacturer's instructions and ASTM E 1643 at concrete slabs.
- C. Install vapor retarders continuously at locations as indicated on the drawings. Ensure there are no discontinuities in vapor retarder at seams and penetrations.
- D. Install vapor retarders in largest practical widths.
- E. Ensure surface beneath vapor retarder is smooth with no sharp projections.
- F. Join sections of vapor retarder and seal penetrations in vapor retarder with mastic tape. Ensure vapor retarder surfaces to receive mastic tape are clean and dry.
- G. Immediately repair holes in vapor retarder with self-adhesive repair tape.
- H. Seal around pipes and other penetrations in vapor retarder with pipe boots in accordance with manufacturer's instructions.

3.3 PROTECTION

- A. Protect reinforced vapor retarders from damage until covered by roof insulation.
- B. Protect reinforced vapor retarders from damage until covered by wall finish.
- C. Protect reinforced vapor retarders from damage during installation of reinforcing steel and utilities and during placement of granular materials or concrete slab.
- D. Immediately repair damaged vapor retarder in accordance with manufacturer's instructions.

END OF SECTION 072600

SECTION 072726 – FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERALRELATED 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 fluid-applied, vapor-retarding membrane air barriers.

1.3 DEFINITIONS

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

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

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

1.6 INFORMATIONAL SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by the manufacturer.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 1. Build integrated mockups of exterior wall assembly , 100 sq. ft., incorporating backup wall construction, ties and other penetrations, and flashing to demonstrate surface preparation, and sealing of gaps, terminations.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

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

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Henry Company, Sealants Division; Air-Bloc 32MR or a comparable product such as the following:
 - a. Hohmann & Barnard, Inc; Enviro-Barrier.
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.00012 cfm/sq. ft. pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Maximum 0.08 perm; ASTM E 96/E 96M.
 - c. Color Cured: Beige.
 - d. Coverage Rate: 14-22 sq. ft. per gallon.

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.

- D. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
- E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- G. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- H. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil- (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with galvanized-steel termination bars and fasteners.
- I. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."
- J. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that masonry joints are flush and completely-filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch (6 mm) with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers,

exterior door framing, and other construction used in exterior wall openings, using accessory materials.

- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply elastomeric flashing sheet so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.
 - 1. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, counterflashing strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fish-mouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Apply primer to substrates at required rate and allow it to dry.

2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than twenty-four (24) hours.
 3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in one or more equal coats.
- C. Apply strip and transition strip a minimum of 1 inch (25 mm) onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufactured through-wall flashing with snaplock receiver.
 - 2. Manufactured reglets with counterflashing.
 - 3. Formed Custom Roof Edge.

1.3 COORDINATION

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

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
 - B. Shop Drawings: For sheet metal flashing and trim.
 1. Include plans, elevations, sections, and attachment details.
 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 5. Include details for joining, supporting, and securing, including layout, and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of special conditions and Custom Roof Edges.
 9. Include details of connections to adjoining work.
 - C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
 - D. Samples for Verification: For each type of exposed finish.
 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Custom Roof Edges: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Sample Warranty: For special warranty.
- 1.7 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical custom roof edge, approximately 10 feet (3.0 m) long, including supporting construction cleats, seams, attachments and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

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

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No.8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, non-toxic, non-staining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Epoxy Seam Sealer: Two-part, non-corrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet Corporation; 'MA-4' Masonry Reglet, 4-inch top flange.
 - 2. Material: Galvanized steel, 0.022 inch (0.56 mm) thick.

3. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
4. Accessories:
 - a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
5. Finish: With manufacturer's standard color coating, color to be selected by Architect.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Custom Roof Edges: Fabricate to configurations detailed with prefinished metal, metallic Kynar 500 finish.
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

- G. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
 - 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of unless otherwise indicated.

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

3.5 ERECTION TOLERANCES

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

3.6 CLEANING AND PROTECTION

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

END OF SECTION 076200

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SECTION 078413 - PENETRATION FIRESTOPPING

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. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system 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 materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to 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 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

- a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 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 Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Hilti, Inc.
 - d. RectorSeal.
 - e. Specified Technologies, Inc.
 - f. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:
 1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. 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 non-shrinking, homogeneous mortar.

- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 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 immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials 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 where recommended in writing by manufacturer 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

- A. General: Install penetration firestopping systems to comply 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.
 - 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 (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 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

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SECTION 078443 - JOINT FIRESTOPPING

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. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT 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 per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Basis of Design: 3M Fire Protection Products.
- C. 3M Fire Barrier Sealant FD 150+: Single-part, water-based sealant. Sag-resistant, low-shrinkage, low VOC, UL 2079.
 - 1. Fire Resistance: For use in 1-, 2-, 3-, or 4-hour fire-rated systems.
 - 2. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall and floor-to-floor.
 - 3. Compression/Extension Recovery: +/- 19 percent of original joint width.
 - 4. Meets optional L rating requirements.
- D. 3M Fire Barrier Water Tight Sealant 1000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC, UL 2079.
 - 1. Fire Resistance: For use in 1-, 2-, 3-, or 4-hour fire rated systems.
 - 2. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - 3. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-floor, floor-to-wall, and perimeter joints.
 - 4. Compression/Extension Recovery: +/- 15 percent of original joint width.
- E. 3M Fire Barrier Water-Tight Sealant 1003 SL: Single-part, self-leveling elastomeric silicone sealant. Sag-resistant, low VOC, UL 2079.
 - 1. Fire Resistance: For use in 1-, 2-, 3-, or 4-hour fire rated systems.
 - 2. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - 3. Location: For use at top-of-wall, bottom-of-wall, floor-to-wall, and floor-to-floor joints.
 - 4. Compression/Extension Recovery: +/- 15 percent of original joint width.
- F. 3M Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC, UL 2079.
 - 1. Fire Resistance: For use in 1-, 2-, 3-, or 4-hour fire rated systems.
 - 2. Service Flexibility: Accommodate vibration from normal building movement.
 - 3. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall, floor-to-floor, and perimeter joints.
 - 4. Compression/Extension Recovery: +/- 31 percent of original joint width.

- G. 3M Fire Barrier Sealant 2000+: Silicone Sealant: Single-part, elastomeric silicone sealant. Sag-resistant, low VOC, UL 2079.
 - 1. Fire Resistance: For use in 1-, 2-, 3-, or 4-hour fire rated systems.
 - 2. Compression/Extension Recovery: +/- 13 percent of original joint width.
 - 3. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall and floor-to-floor joints.
- H. 3M FireDam Spray 200: Water-based, paintable, low VOC, freeze/thaw resistant spray applied fire resistive product. Applied with conventional airless spray equipment, UL 2079.
 - 1. Fire Resistance: For use in 1-, 2-, 3-, or 4-hour fire rated systems.
 - 2. Compression/Extension Recovery: +/- 50 percent of joint width.
 - 3. Location: For use at head-of-wall, wall-to-wall, floor-to-floor, bottom-of-wall, floor-to-wall, and perimeter joints.
- I. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- J. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- K. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 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 fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials 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 where recommended in writing by joint firestopping system manufacturer 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

- A. General: Install fire-resistive joint systems to comply 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 fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches (150 mm)**

of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 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 fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078443

SECTION 079200 – JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-staining silicone joint sealants.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch (13 mm) wide joints formed between two)2) 6-inch (150 mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint Sealant Schedule: Include the following information:
 - 1. Joint sealant application, joint location, and designation.
 - 2. Joint sealant and backer rod compatibility.
 - 3. Joint sealant manufacturer and product name.
 - 4. Joint sealant formulation.
 - 5. Joint sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. 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 (5) years from date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

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

2.2 NON-STAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Non-staining, S, NS, 50, NT: Non-staining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation; 756 SMS.
 - b. GE Construction Sealants; Mumentive Performance Materials Inc.; Silpruf NB.
 - c. Pecora Corporation; 898NST.
 - d. Tremco Incorporated; Spectrem 3.

2.3 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

- a. BASF Corporation-Construction Systems; MasterSeal 920 & 921 (Pre-2014: Sonolastic Backer Rod.)
- B. Cylindrical Sealant Backings: ASTM C 1330, 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. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective

- coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Joints between different materials listed above.
 - c. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - d. Control and expansion joints in ceilings and other overhead surfaces.

- e. Other joints as indicated on Drawings.
- 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Acoustical-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

- B. VOC Content of Interior Sealants: Sealants and sealant primers shall comply with the following:
 - 1. Acoustical sealants and sealant primers shall have a VOC content of 250 g/L or less.
- C. Low-Emitting Interior Sealants: Acoustical sealants and sealant primers shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex acoustical sealant complying with ASTM C 834.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide United States Gypsum Company; SHEETROCK Acoustical Sealant.
 - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Non-porous 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 non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, non-absorbent 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 C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

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 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

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 interior expansion joint cover assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples: For each expansion joint cover assembly and for each color and texture specified, full width by 6 inches (150 mm) long in size.
- D. Samples for Initial Selection: For each type of exposed finish.
 - 1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric-seal material.
- E. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

2.3 FLOOR EXPANSION JOINT COVERS

- A. Metal-Plate Floor Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, or approved equal.
 - 2. Application: Floor to floor.
 - 3. Model numbers: GFS. Coordinate size with size of expansion joints.
 - 4. Installation: Surface-mounted.
 - 5. Load Capacity:
 - a. Uniform Load: 50 lb./sq. ft. (244 kg/sq. m).
 - b. Concentrated Load: 300 lb. (136 kg).

- c. Maximum Deflection: 0.0625 inch (1.6 mm).
- 6. Fire-Resistance Rating: Not less than that of adjacent construction.
- 7. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I.

2.4 WALL EXPANSION JOINT COVERS

- A. Metal-Plate Wall Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, or approved equal.
 - 2. Application: Wall-to-wall.
 - 3. Model No. FCS. Coordinate size with expansion joint size.
 - 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 5. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I.

2.5 CEILING EXPANSION JOINT COVERS

- A. Metal-Plate Ceiling Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, or approved equal.
 - 2. Application: Ceiling-to-ceiling.
 - 3. Model Number: FCS. Coordinate size with expansion joint size.
 - 4. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 5. Exposed Metal:
 - a. Aluminum: Clear anodic, Class I.

2.6 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
 - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

2.7 ALUMINUM FINISHES

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

2.8 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
 - 1. Provide where indicated on Drawings.
- B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 - 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 - 2. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 - 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 079513.13

SECTION 079513.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

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 exterior building expansion joint cover assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified, full width by 6 inches (150 mm) long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.
 - 7. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.

2.3 EXTERIOR EXPANSION JOINT COVERS

- A. Exterior Elastomeric-Seal Joint Cover Type 1: Assembly consisting of elastomeric seal anchored to surface-mounted frames fixed to sides of joint gap.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Construction Specialties, Inc.; Model HS-200.

- b. EMSEAL, a Sika Company; Colorseal.
- 2. Application: Wall-to-wall.
- 3. Installation: Recessed.
- 4. Seal: Preformed elastomeric extrusion.
 - a. Color: As selected by Architect from manufacturer's full range.

2.4 MATERIALS

- A. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

2.5 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
 - 1. Provide where indicated on Drawings.
- B. Manufacturer's standard adhesive for attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals to substrates with adhesive or pressure-sensitive tape as recommended by manufacturer.
- C. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.16

SECTION 081113 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Hollow metal doors.
 - 2. Hollow metal frames.
- B. Exclusions: Metal for the following is not provided under the scope of this section:
 - 1. Structural steel.
 - 2. Headers and lintels.
 - 3. Framing.
 - 4. Steel channel frames.
 - 5. Access panels.
- C. Related Sections:
 - 1. Division 01 Section "Alternates" for alternates affecting the work of this section.
 - 2. Division 07 Section "Joint Sealants"
 - 3. Division 08 Section "Door Hardware"
 - 4. Division 08 Section "Glazing"
 - 5. Division 09 Sections for touchup finishing or refinishing of existing openings modified by the work of this section.
 - 6. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
 - 7. Division 28 Sections for coordination with other components of other components of electronic access control system.

1.3 REFERENCES

- A. Fire/Life Safety
 - 1. NFPA - National Fire Protection Association

- a. NFPA 70 – National Electric Code
 - b. NFPA 80 - Standard for Fire Doors and Fire Windows
 - c. NFPA 101 - Life Safety Code
 - d. NFPA 105 - Smoke and Draft Control Door Assemblies
2. State Fire Safety Code.
- B. UL - Underwriters Laboratories
 1. UL 10C - Positive Pressure Test of Fire Door Assemblies
 2. UL 1784 - Air Leakage Tests of Door Assemblies
- C. Accessibility
 1. ADA - Americans with Disabilities Act.
 2. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- D. SDI – Steel Door Institute
 1. SDI 100/ANSI A250.8 - Recommended Specifications - Standard Steel Doors and Frames.
 2. SDI 105 - Recommended Erection Instructions for Steel frames.
 3. SDI 111 - Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
 4. SDI 112 - Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
 5. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
 6. SDI 118 - Basic Fire Door Requirements.
 7. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 8. SDI 124 - Maintenance of Standard Steel Doors and Frames.
- E. DHI - Door and Hardware Institute
 1. Sequence and Format for the Hardware Schedule
 2. Recommended Locations for Builders Hardware
- F. ANSI - American National Standards Institute
 1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties
 2. ANSI A250.3-2001 - Test Procedure and Acceptance Criteria for - Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
 3. ANSI A250.4-2001 - Test Procedure and Acceptance Criteria for - Physical Endurance for Steel Doors, Frames, Frame Anchors, and Hardware Reinforcings.
 4. ANSI A250.6-2003 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

5. ANSI A250.10-1998 - Test Procedures and Acceptance Criteria for – Prime Painted Steel Surfaces for Steel Doors and Frames.
 6. ANSI A250.11-2001 - Recommended Erection Instructions for Steel Frames.
- G. ASTM - American Society for Testing and Materials
1. ASTM-A1008/A1008M-00 - Specification for Commercial Steel (CS) Sheet, Carbon, Cold-Rolled.
 2. ASTM-A568/A568M - Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled.
 3. ASTM-A653/A653M - Specification for Steel Sheet, Zinc-Coated or Zinc-Iron Alloy-Coated by the Hot Dip Process.
 4. ASTM-A36/A36M-05 - Standard Specification for Carbon Structural Steel.
 5. ASTM C1363-11 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
 6. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
 7. ASTM E 413 - Classification for Rating Sound Insulation.

1.4 SUPPLIER QUALIFICATIONS

- A. Hollow Metal Supplier shall maintain at the location which will be managing the project, a credentialed Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) as a full-time employee, and member in good standing of DHI - Door Security + Safety Professionals.
- B. Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) shall supervise other individuals employed by the Door and Frame Supplier who work on the project and be available throughout the project to meet with the Contractor, Architect or Owner as needed.
- C. Supplier shall be experienced and have completed projects with material, design, and scope similar to that specified for this project. If requested by the Owner or Architect, submit a list of projects completed in the last five (5) years with the project name, location, Owner, Architect and Contractor.
- D. Failure to meet the above requirements will disqualify the bidder.
- E. The Owner may visit the Supplier's office and warehouse to observe if the intent of the requirements set forth in the specifications have been met.

1.5 SUBMITTALS

- A. General:

1. Submit the following in accordance with conditions of contract and Division 01 requirements.
2. Advise Architect within the submittal package of incompatibility or issues which may detrimentally affect the work of this section.
3. Prior to forwarding submittal: Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Provide illustrations from manufacturer's catalogs and data in brochure form for all products, including model, function, design, finish, and options.
2. Samples for Verification: If requested by the Architect, submit production samples or sample installations of each type of frame joining corners and butt details, door cores and edge constructions, and finish sample, tagged with a full description for coordination with the schedule.
3. Door Hardware Schedule: Organize schedule into spreadsheet format indicating complete designations of every item required for each door and frame. Door and frame schedule shall clearly indicate architect's door number, elevations, and notes:
4. Templates: After final approval of the door and frame schedule, provide listing of manufacturer's hardware locations for each item of hardware.

C. Informational Submittals:

1. Qualification Data: For supplier, installer, and Certified Door Consultant.
2. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated doors and frames and installation instructions shall be made available upon request of Architect or authority having jurisdiction.
 - b. Submit manufacturer certification that doors and frames have been tested and comply with ANSI-A250.4, Level "A", 1,000,000 cycle test criteria and other requirements as listed in these specifications.
 - c. Submit manufacturer certification that fire rated doors and frames comply with UBC 7-2 1997 or UL10C, Category "A", Positive Pressure Fire Test of Door Assemblies.
3. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for doors and frames located in accessible routes.
4. Warranty: Warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include the following:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representatives for each manufacturer.
 - d. Copy of final approved door and frame schedule, edited to reflect conditions as-installed.
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.

1.6 QUALITY ASSURANCE

- A. Product Substitutions: For the purpose of performing the work of this section, comply with product requirements stated in Division 01 and as specified herein.
 1. Where a specific manufacturer's product is named and accompanied by the words "No Substitute," including make or model number or other designation, provide the product exactly as specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in a product category, requirements for "No Substitute" govern product selection.
 2. Where products indicate "acceptable substitute" or "acceptable manufacturer", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- B. Supplier Qualifications and Responsibilities: A recognized hollow metal door and frame supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying hollow metal doors and frames similar in quantity, type, and quality to that indicated for this project and that provides a Certified Door Consultant (CDC) available to the Owner, Architect, and Contractor, at reasonable times during the course of the work for consultation.
 1. Warehousing Facilities: In project's vicinity.
 2. Scheduling Responsibility: Preparation of hollow metal door and frame schedules.
 3. Engineering Responsibility: Preparation of data for field spliced or field modified units, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this project.

4. Coordination Responsibility: Coordinate preparation of the door hardware and provide installation and technical data to the Architect and other related subcontractors.
 - a. Upon completion of hollow metal door and frame installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in the application of hollow metal doors and frames that has a record of successful in-service performance for installing hollow metal doors and frames similar in quantity, type, and quality to that indicated for this project.
- D. Certified Door Consultant Qualifications: A person who is experienced in providing consulting services for commercial doors that are comparable in material, design, and extent to that indicated for this project and who can meet the following qualification requirements:
 1. For door hardware, DHI-certified, Certified Door Consultant (CDC).
 2. Can provide installation and technical data to the Architect and other related subcontractors.
 3. Can inspect and verify components are in working order upon completion of installation.
- E. Single Source Responsibility: Obtain each type of hollow metal door and frame from a single manufacturer.
- F. Fire-Rated Openings: Provide doors and frames for fire-rated openings that complies with NFPA Standard No. 80, UBC 7-2 1997 or UL10C, Category "A", Positive Pressure Test of Fire Door Assemblies, and requirements of authorities having jurisdiction. Provide only doors and frames that are labeled and listed for ratings indicated by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to the authorities having jurisdiction.
 1. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.
 2. Temperature Rise Rating: Provide doors that have temperature rise rating of 450 degrees F (232C) or 250 degree F (121 C) maximum in thirty (30) minutes of fire exposure in accordance with local building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Tag each item or package separately with identification related to the final door and frame schedule, and include installation instructions with each delivery.
- B. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - a. Door Storage: Store doors in upright position, under cover. Place doors on at least 4-inch-high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove all packaging immediately. Provide 1/4-inch (6.3) space between doors to promote air circulation.
 - b. Frame Storage: Store frames under cover on 4-inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, five (5) units maximum in stack. Provide 1/4 inch space between frames to promote air circulation.
- C. Protection and Damage:
 - 1. Promptly replace products damaged during shipping with exactly the same products.
 - 2. Handle doors and frames in manner to avoid damage, marring, or scratching. Correct, replace, or repair products damaged during the course of the Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

1.8 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. See Division 03 for concrete, reinforcement, and formwork requirements.
- B. Coordinate hardware mounting heights as specified under Section 087100.
- C. Installation: Check shop drawings of other work to confirm that adequate provisions are made for locating and installing doors and frames to comply with indicated requirements.
- D. Electrical System Roughing-In: Coordinate layout and installation of doors and frames with electrified door hardware connections.

1.9 WARRANTY

- A. Provide manufacturer's warranties as specified in Division 01 and as follows:
 - 1. Hollow Metal Doors and Frames: One (1) year from Date of Substantial Completion.
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use, or abuse.

1.10 MAINTENANCE

- A. Maintenance Instructions: Furnish a complete set of maintenance instructions as needed for Owner's continued maintenance of doors and frames.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as, "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each door and frame for proper installation and operation of door movement as shown.
- C. Where the door and frame specified is not adaptable to accept the finish hardware specified, furnish suitable type having the same operation and quality as the type specified, subject to the Architect's approval.

2.2 EXISTING MATERIALS

- A. Where existing doors and/or frames are indicated to be removed and reinstalled:
 - 1. Carefully remove doors, frames, and/or components.
 - 2. Clean, protect and store existing doors and/or frames in accordance with storage and handling requirements specified herein.
 - 3. Reinstall in accordance with installation requirements for new doors and/or frames.

2.3 MATERIALS

- A. Fasteners

1. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide manufacturers standard screws. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with manufacturer's standard self-tapping screws.
- B. Modification and Preparation of Existing Doors and/or Frames: Provide necessary fillers, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 1. When possible, use materials which match materials of adjacent modified areas.
 2. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

2.4 HOLLOW METAL FRAMES

A. Manufacturer:

1. Scheduled Manufacturer: Steelcraft.
2. Acceptable Substitute: Ceco, Curries, Republic.

B. Requirements:

1. Provide hollow metal frames as scheduled, and drawn and detailed on plans, with the provisions below.
2. Cold Rolled Steel Sheets: Commercial quality, stretcher-leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM-A1008/A1008M-00 and ASTM-A568 general requirements.
3. Galvannealed Steel Sheets: ASTM-A653, A60 zinc coating. Use galvannealed steel sheets for exterior hollow metal frames. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
4. Minimum gages of hollow metal frames are specified below in compliance with SDI 100/ANSI A250.8. Provide heavier gage if required by code, details, specific condition, or to meet specified standards. Entire frame and sidelight shall be of same gage. Frames must have been tested and comply with ANSI-A250.4, Level "A", 1,000,000 Cycle Test Criteria.
 - a. Level 3 (16 gage): Interior door, transom, and sidelight frames with nominal door width up to 48 inches.
 - b. Level 4 (14 gage): Interior door, transom, and sidelight frames with nominal door width over 48 inches.
 - c. Level 3 (16 gage): Interior window-wall frames and borrowed light frames.
 - d. Level 4 (14 gage) Galvannealed: Exterior frames.
5. Steel Reinforcing: Meeting ASTM-A36/A36M-05 – Standard Specification for Carbon Structural Steel.

6. General: Form to profiles indicated. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.
7. Anchorage: Provide a minimum of three (3) anchors per jamb up to 84 inches high. For longer jambs, provide sufficient anchors to permit maximum spacing of 24 inches on center. Provide welded anchors at welded frames unless detailed or noted otherwise. Provide standard and special anchorage items as required. At masonry jambs provide wire anchors. Provide 16 gage angle clips welded in place at bottom of each jamb with two punched holes for securing frames to floor. Where dictated by fire rating testing laboratory procedures, supply anchors complying with such requirements. All frames shall be provided with two temporary steel spreaders welded to the feet of the jambs to serve as bracing during shipping and handling only. These shall be removed prior to installation and are not to be used for setting of proper frame tolerances.
8. Extensions: Reinforce transom bars or mullions as necessary to provide rigid installation.
9. Mullions: Provide mullions straight and without twist of tubular design. For removable mullions provide fastenings of non-ferrous bolts at bottom, with sleeves at head of frame for mullion to clip over.
10. Clearances: Provide proper clearances at metal frames, including for glass/glazing, gasketing, and sound stripping.
11. Glass Stops: Where specified or indicated on drawings, frames shall be supplied with removable glass moldings. These shall be formed "U" shaped steel of the same gage as the frame. All stops shall have tightly fitted butted or mitered corners and shall be secured with manufacturer's standard self-tapping screws no more than 10 inches on center or as required, on fire rated frames, by manufacturers labeling authority.
12. Hospital Stops: Where shown or noted on drawings except at frames for lead-lined doors, doors in 2-hour fire rated partitions, and one hour smoke and fire rated partitions, stops shall be cut at 5-1/2 inches above floor with 45 degree miter and welded closed.
13. Labeled Frames: Construct in accordance with requirements for labeled work. Attach proper metal U.L. or Warnock Hersey label. "B" labeled frames shall be 1-1/2 hour construction. Embossed labels are not acceptable.

2.5 HOLLOW METAL DOORS AND PANELS – FLUSH TYPE

A. Manufacturer:

1. Scheduled Manufacturer: Steelcraft.
2. Acceptable Substitute: Ceco, Curries, Republic.

B. Requirements:

1. Provide flush hollow metal doors as scheduled, and drawn and detailed on plans, with the provisions below.
2. Cold Rolled Steel Sheets: Commercial quality, stretcher-leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM-A1008/A1008M-00 and ASTM-A568 general requirements.
3. Galvannealed Steel Sheets: ASTM-A653, A60 zinc coating. Use galvannealed steel sheets for exterior flush hollow metal doors with smooth non-wood grain surface and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
4. Galvannealed Wood Grain Embossed Steel Sheets: ASTM-A653, A40 zinc coating. Use galvannealed wood grain embossed steel sheets for embossed panel hollow metal doors with wood grain stainable surface. Steel shall have an embossed wood grain pattern extending the full height and width of the door. Provide wood grain embossment minimum .005 inches deep. Applied grain pattern or material is not acceptable. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A568.
5. Minimum gages of flush hollow metal doors are specified below in compliance with SDI 100/ANSI A250.8. Provide heavier gage if required by code, details, specific condition, or to meet specified standards. Doors must have been tested and comply with ANSI-A250.4, Level "A", 1,000,000 Cycle Test Criteria.
 - a. Level 2 (18 gage): Interior doors.
 - b. Level 3 (16 gage) Galvannealed: Exterior doors.
6. Steel Reinforcing: Meeting ASTM-A36/A36M-05 – Standard Specification for Carbon Structural Steel.
7. Provide to design indicated including: Flush panel doors, cut-outs as indicated, lite kits, and/or door louvers. Use galvannealed steel at exterior doors.
8. Flush Doors: Reinforce, stiffen and sound deaden. Provide steel inverted closure at top of doors. Provide manufacturers standard screwed-in steel top cap at exterior doors, except at doors with concealed overhead stops. Following door construction types are acceptable.
 - a. Exterior Doors: Polystyrene core or Polyurethane core laminated to inside faces of both panels using contact adhesive accordance with SDI standards tested and complying with ASTM C1363 with a minimum operable R-Factor of 2.08.
 - b. Interior Doors: Impregnated Kraft honeycomb core, polystyrene core, or polyurethane core laminated to inside faces of both panels using contact adhesive accordance with SDI standards.
9. Labeled Doors: Mark as required by Underwriters Laboratories or Warnock Hersey. Build in special hardware reinforcements and provide astragals as required.
10. Vertical Edges: Doors shall be Model 1 full flush – visible seam.

2.6 FINISHES

- A. Frames: Clean frames by degreasing process and apply thorough coating of baked-on shop primer conforming to ANSI A250.10, covering inside as well as outside surfaces. After welding, grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Coat welds and other disrupted surfaces with manufacturer's standard rust inhibiting primer conforming to ANSI A250.10.
- B. Doors: Thoroughly clean off rust, grease and other impurities. Grind welds smooth, allowing no marks to show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Apply thorough coating of manufacturer's standard rust inhibiting shop primer conforming to ANSI A250.10.
- C. Pre-stained Wood Grain Doors: Thoroughly clean off rust, grease and other impurities. Grind welds smooth, allowing no marks to show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth. Apply thorough coating of manufacturer's standard stain absorbing rust inhibiting shop primer conforming to ANSI A250.10. Stain the door faces and edges using conventional stains to achieve a Maple color. Finish after staining with a clear coat that contains UV inhibitors and provides graffiti resistance. Pre-finish stain to be applied over manufacturer's standard stain-absorbing primer. Finish stain to comply with ANSI A250.3-1993 "Test Procedure and Acceptance Criteria for – Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames".

2.7 ACCESSORIES

- A. Glass Trim at Flush Doors: Where scheduled, doors shall be provided with manufacturer's standard trim or vision kits for glass sizes and thickness shown on approved submittals. Provide trim or vision kits, at doors with glass up to 1/2-inch thick that do not extend beyond the door face. Provide trim or vision kits at doors with glass over 1/2-inch thick that cap the cutout but do not extend more than 1/16-inch from the door face. Provide trim or kits of 24-gage cold rolled steel at non-galvanized doors and hot dipped galvanized or galvanized doors. Exposed fasteners are not permitted.
- B. Louvers: Provide 1-inch thick inverted "Y" blade type louvers that are inserted into an opening prepared in the door faces. Louver blades shall be fabricated from 18 gage cold-rolled steel and welded to a fabricated sub-frame. The louver is held in place by a retaining frame or shroud furnished with the louver.

- C. Glass: Refer to Division 08 - Glass and Glazing for glass types.

2.8 FABRICATION

- A. Fabricate doors and frames in accordance with requirements of ANSI A250.8-2003/SDI 100.
- B. Fabricate fire rated doors in accordance with requirements of ITS – Warnock Hersey or Underwriters' Laboratories, with metal label on each door and frame including UBC 7-2 1997 or UL-10C Category "A".
- C. Typical Frame Reinforcing: Provide steel reinforcement as required for hardware items per manufacturers templates. Provide minimum hinge reinforcement 9-gage by 1-1/2 inch by 9-inch and lock strike reinforcement 16-gage 1-inch by 1-1/2 inch by 4-inch long. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 14-gage, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head door closers and mortised locks. Reinforcing as provided for in ANSI-A250.6.
- D. Mortar Guards in Frames: For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.
- E. Hardware Preparation at Frames: Mortise, reinforce, drill, and tap as required for all mortised hardware furnished under Division 08 Finish Hardware and/or Division 26 Security in accordance with a final approved hardware schedule and templates provided by the hardware supplier and/or security supplier (including electric hinges and/or power transfers, door position switches, and other electrified hardware). Drilling and tapping for surface door closers, door closer brackets, and adjusters shall be done in field by hardware installer. Provide metal mortar guards for all mortised cutouts for frames in masonry walls and/or frames being grout filled. Obtain templates from hardware and security suppliers. Provide hardware preparation per ANSI-A250.6.
- F. Joining at Frames: At frames with equal width jambs and head, neatly miter on face and cope and butt stops. At other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly. Weld length of entire frame faces and grind smooth. Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints. Joints shall be finished and primed.

- G. At frames with equal width jambs and head, neatly miter on face and cope and butt stops. At other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly. Weld length of entire joint, including faces, rabbets, stops, soffit, and other flat intersections, and grind smooth. Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints. Joints shall be finished and primed.
- H. Provide bevel lock edge of single acting swinging doors 1/8-inch in 2 inches. Provide radius edge of double acting swing doors as required by pivot hinge manufacturer. Provide square edge on sliding doors and panels.
- I. Typical Door Reinforcement: Provide steel reinforcement as required for hardware items per manufacturers' templates. Provide 7-gage steel hinge reinforcements. Provide 16-gage steel lock reinforcements, and 14-gage steel channel or box type closer reinforcement minimum 6 inches high and 20 inches long. Projection weld hinge and lock reinforcements to the edge of the door. Provide adequate reinforcements for other hardware as required. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface overhead holders and stops. Reinforcing as provided for in ANSI-A250.6.
- J. Hardware Preparation at Doors: Mortise, reinforce, drill, and tap as required for all mortised hardware furnished under Division 08 Finish Hardware and/or Division 28 Access Control in accordance with a final approved hardware schedule and templates provided by the hardware supplier and/or security supplier (including a minimum 1/2-inch raceway for electrical hardware, electric hinges and/or power transfers, door position switches, and other electrified hardware). Drill and tap for surface door closers, door closer brackets, and adjusters in field. Obtain templates from hardware and security suppliers. Provide hardware preparation per ANSI-A250.6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of any doors and frames, examine supporting structure and conditions under which hollow metal doors and frames are to be installed. Correct all defects prior to proceeding with installation.

3.2 PREPARATION

- A. Where on-site modification of doors and frames is required, prepare hardware locations in accordance with the following:
 - 1. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - 2. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - 3. Where doors are in rated assemblies, comply with NFPA 80 for restrictions on on-site door hardware preparation.
 - 4. Where on-site modification of existing doors and frames is required:
 - a. Remove existing hardware being replaced, tag, and store according to contract documents.
 - b. Field modify and prepare existing door and/or frame for new hardware being installed.
 - c. When modifications are exposed to view, use concealed fasteners, when possible.

3.3 INSTALLATION

- A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship. Set hollow metal plumb, level, square to proper elevations, true to line and eye. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.
- B. Placing Frames: Remove manufacturer's shipping spreader-bars prior to installation. These shall not be used for setting of proper frame tolerances. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set in accordance with ANSI A250.11. After wall construction is complete, remove temporary braces and/or installation spreaders leaving surfaces smooth and undamaged. In masonry construction, building-in of anchors and grouting of frames with mortar is specified in Division 04 Section - Unit Masonry. At in-place concrete or masonry construction, set frames and secure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.
- C. Place fire-rated frames in accordance with NFPA 80, and/or manufacturers' follow-up procedure requirements.
- D. Door Installation: Fit hollow metal doors accurately in their respective frames, within following clearances: Jambs and head 1/8-inch, meeting edges pair of doors 1/8-

inch, sill where no threshold or carpet 1/4-inch above finished floor, sill at threshold 3/4-inch maximum above finished floor, sill at carpet 1/4-inch above carpet. Place fire-rated doors with clearances as specified in NFPA 80.

3.4 FIELD QUALITY CONTROL

- A. After installation of frames has been completed, a qualified person from the hardware installation company is to check the project to confirm the proper installation of frames to allow for the proper installation of doors and finish hardware scheduled.
- B. Installer shall deliver to owner, upon completion, one set of installation and maintenance instructions for doors and frames.

3.5 ADJUSTING

- A. Final Adjustments: Adjust doors and hardware prior to final inspection and acceptance by the Architect and Owner. Replace defective items including doors or frames that are damaged or unacceptable to the Architect and Owner.
- B. Fire Door Assembly Inspection and Testing: Upon completion of the installation, provide functional testing and inspection of each fire door assembly on the project to confirm proper operation and that it meets all criteria of a fire door assembly as per NFPA 80, 2007/2010 edition. Inspections shall be performed by individuals with knowledge and understanding of the operating components of the door being subjected to testing and who are certified by Intertek as a Fire Door Assembly Inspector (FDAl) or a credentialed Architectural Hardware Consultant (AHC). A written report using reporting forms provided by the Door and Hardware Institute shall be maintained and transmitted to the Owner and made available to the Authority Having Jurisdiction (AHJ). The report shall list each fire door throughout the project, and include each door number, location, hardware set used and summary of deficiencies.
 - 1. Schedule fire door assembly inspection within ninety (90) days of substantial completion of the project.
 - 2. Correct all deficiencies and schedule a re-inspection of fire door assemblies which were noted as deficient on the inspection report.
 - 3. Inspector shall re-inspect fire door assemblies after repairs are made.
 - 4. Additional re-inspections which are required due to incomplete repairs will be performed by the inspector at the expense of the Contractor.
- C. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

3.6 PROTECTION

- A. Provide for the proper protection of doors and frames until the Owner accepts the project as complete. Damaged or disfigured doors and frames shall be replaced or repaired by the responsible party.

END OF SECTION 081113

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SECTION 081416 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 4. Fire Rated Transom / Sidelight Panels.
- B. Related Sections:
 - 1. Division 08 Section "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
 - 1. Adhesives and composite wood products, certification product contains no urea formaldehyde.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.

E Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B Source Limitations: Obtain flush wood doors from single manufacturer.
- C Qualify that adhesives and composite wood products contain no urea formaldehyde.
- D Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated." WDMA I.S.1-A, "Architectural Wood Flush Doors."
1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- E Forest Certification: Provide doors made with all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- F 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 NFPA 252 or UL 10B / UL 10C.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after thirty (30) minutes of standard fire-test exposure.
- G Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Per manufacturers written temperature and humidity requirements.

1.7 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.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42 by 84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.

3. Marshfield Door Systems, Inc.
4. Mohawk Flush Doors, Inc.; a Masonite Company.
5. Oshkosh Architectural Door Company.
6. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Particleboard-Core Doors:
 1. Particleboard: ANSI A208.1, Grade LD-2.
 2. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- D. Structural-Composite-Lumber-Core Doors:
 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
- E. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- F. Mineral-Core Doors:
 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.
2. Species: Select white maple.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Exposed Vertical and Top Edges: Same species as faces Applied wood edges of same species as faces and covering edges of crossbands.
8. Core: Particleboard or Structural composite lumber.
9. Construction: Five plies. Stiles and rails are bonded to core then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
10. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES

- ### A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
1. Wood Species: Same species as door faces.
 2. Profile: Flush rectangular beads.
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- ### B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- ### C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.
- ### D. Metal Frames for Light Opening in Doors with Security Glass and Fire-Protection-Rated Security Glass:
1. Manufacturer: Basis-of-design product, provide National Guard Products Thru-bolted Lite Kit, model L-GLF100-TB or L-GLF100-SP-TB depending on glazing thickness, or approved equal.

2. Lite Kit to be powder-coated. Color to be selected by Architect from Manufacturer's full range.

E. Vision Lite Privacy Screen:

1. Manufacturer: Basis-of-design product, provide School Safety Solutions, Hideaway Helper Lockdown Window Shade, or approved equal.
2. Color: Black.
3. Locations: All Classroom and Office doors.
4. Accessories: Weighted Hem Bar.

2.5 Fire Rated Transom / Sidelight Panels

- A. Manufacturer: Basis-of-design product, provide Graham-Maiman, an ASSA ABLOY Group company, Fire Rated Transom Panels. Substitutions shall comply with Section 016000 – Product Requirements.

1. For transom panels up to 90-minute fire rating: max size (4'-0" W x 3'-4" H).
2. For sidelight panels up to 90-minute fire rating: max size (4'-0" W x 9'-0" H).
3. Maximum allowed clearance between frame and transom or sidelight panel cannot exceed 1/8-inch on all four sides.
4. All fire-rated transom and sidelight panel frames shall be field prepped by the GC to accommodate a 3/8-inch diameter hole in frame for spring bolts.
5. Sizes: Coordinate sizes and fire ratings with Door Schedule located in bid documents.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory-machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

- C. Openings: Cut and trim openings through doors in factory.

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 Division 08 Section "Glazing."
3. Louvers: Factory-install louvers in prepared openings.

2.7 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: AWI catalyzed polyurethane.
 3. Staining: As selected by Architect from manufacturer's full range.
 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jams.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install non-rated wood doors per the following clearances, unless otherwise indicated:
 - a. Jamb 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. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
 - a. Jamb and Head: 1/8 inch maximum.
 - b. Between Edges of Pairs of Doors: 1/8 inch maximum.
 - c. Between Bottom of Door and Top of Noncombustible Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Noncombustible Floor Finish (No Threshold): Maximum 3/4 inch.
 - e. Between Bottom of Door and Top of Rigid Floor Tile: Maximum 5/8 inch (16 mm).
 - f. Between Bottom of Door and Top of Class I Floor Covering: Maximum 1/2 inch (12 mm.)
 3. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 4. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- A. Job-Fitted Doors for knock-down hollow metal frames: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
1. Non-Rated Wood Door Clearances: Provide of the following clearances unless otherwise indicated.
 - a. Jamb 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 Wood Door Clearances: Install doors with clearances according to NFPA 80.
 - a. Jamb and Head: 1/8 inch maximum.
 - b. Between Edges of Pairs of Doors: 1/8 inch maximum.
 - c. Between Bottom of Door and Top of Noncombustible Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Noncombustible Floor Finish (No Threshold): Maximum 3/4 inch.

- e. Between Bottom of Door and Top of Rigid Floor Tile: Maximum 5/8 inch.
 - f. Between Bottom of Door and Top of Class I Floor Covering: Maximum 1/2 inch.
 - 3. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 4. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- B. Factory-Fitted Doors for welded hollow metal frames: Align in frames for uniform clearance at each edge.
- 1. Non-Rated Wood Door Clearances: Provide of the following clearances unless otherwise indicated.
 - 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 Wood Door Clearances: Install doors with clearances according to NFPA 80.
 - a. Jambs and Head: 1/8 inch maximum.
 - b. Between Edges of Pairs of Doors: 1/8 inch maximum.
 - c. Between Bottom of Door and Top of Noncombustible Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Noncombustible Floor Finish (No Threshold): Maximum 3/4 inch.
 - e. Between Bottom of Door and Top of Rigid Floor Tile: Maximum 5/8 inch (16 mm).
 - f. Between Bottom of Door and Top of Class I Floor Covering: Maximum 1/2 inch (12 mm.)
- C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang 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

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SECTION 081733 - FRP DOORS AND ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Fiberglass Reinforced Polyester (FRP) Flush Doors in Aluminum Frames, insulated panels, and storefront framing.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Performance Requirements for FRP Pebble Texture Flush Doors:
 - 1. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 79.9 psi.
 - 2. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 370 psi.
 - 3. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 45.3 psi.
 - 4. Thermal and Humid Aging, Foam Core, Nominal Value, 158 Degrees F and 100 percent Humidity for fourteen (14) Days, ASTM D 2126: Minus 5.14 percent volume change.
 - 5. Air Infiltration: For single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 283 at pressure differential of 6.24 psf. Door shall not exceed 0.90 cfm per linear foot of perimeter crack.
 - 6. Water Resistance: For single door 3'-0" x 7'-0", test specimen shall be tested in accordance with ASTM E 331 at pressure differential of 7.50 psf. Door shall not have water leakage.
 - 7. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 25,000,000 cycles.
 - 8. Cycle Slam Test Method, NWWDA T.M. 7-90: Minimum 5,000,000 Cycles.
 - 9. Swinging Security Door Assembly, Doors and Frames, ASTM F 476: Grade 40.
 - 10. Salt Spray, Exterior Doors and Frames, ASTM B 117: Minimum of 500 hours.
 - 11. Sound Transmission, Exterior Doors, STC, ASTM E 90: Minimum of 25.
 - 12. Thermal Transmission, Exterior Doors, U Value, AAMA 1503-98: Maximum of 0.29BTU/hr x sf x degrees F. Minimum of 55 CRF value.
 - 13. Insulated Foam Cores, Non-rated Swinging Doors: IBC 2603.4.1.7, Passed by independent test or meet code. Doors not required to have a fire protection rating. Where pivoted or side-hinged doors are permitted

without a fire protection rating, foam plastic insulation, having a flame spread index of 75 or less and a smoke-developed index of not more than 450, shall be permitted as a core material where the door facing is of metal having a minimum thickness of 0.032-inch (0.8 mm) aluminum or steel having a base metal thickness of not less than 0.016 inch (0.4 mm) at any point.

14. Surface Burning Characteristics, FRP Doors and Panels, ASTM E 84:
 - a. Flame Spread: Maximum of 200, Class C.
 - b. Smoke Developed: Maximum of 450, Class C.
15. Surface Burning Characteristics, Class A Standard On Interior Faces of FRP Exterior Panels and Both Faces of FRP Interior Panels, ASTM E 84:
 - a. Flame Spread: Maximum of 25.
 - b. Smoke Developed: Maximum of 450.
16. Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 256: 15.0 foot pounds per inch of notch.
17. Tensile Strength, FRP Doors and Panels, Nominal Value, ASTM D 638: 14,000 psi.
18. Flexural Strength, FRP Doors and Panels, Nominal Value, ASTM D 790: 21,000 psi.
19. Water Absorption, FRP Doors and Panels, Nominal Value, ASTM D 570: 0.20 percent after 24 hours.
20. Indentation Hardness, FRP Doors and Panels, Nominal Value, ASTM D 2583: 55.
21. Gardner Impact Strength, FRP Doors and Panels, Nominal Value, ASTM D 5420: 120inlb.
22. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.029 average weight loss percentages.
23. Stain Resistance, ASTM D 1308: Face sheet unaffected after exposure to red cabbage, tea, and tomato acid. Stain removed easily with mild abrasive or FRP cleaner when exposed to crayon and crankcase oil.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including description of materials, components, test reports, fabrication, finishes, and installation.
- B. Shop Drawings: Submit manufacturer's shop drawings, including ELEVATIONS, SECTIONS, AND DETAILS, indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.
- C. Samples:

1. Door: Submit manufacturer's sample of Door showing face sheets, core, framing, and finish.
 2. Color: Submit manufacturer's samples of standard colors of Doors and Frames.
- D. Maintenance Manual: Submit manufacturer's maintenance and cleaning instructions for Doors, including maintenance and operating instructions for hardware.
- E. Warranty: Submit manufacturer's warranty as described in this specification.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: FRP Door, immediate door frame, sidelites and transoms shall be components from same manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying opening door mark and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish from damage during handling and installation.

1.7 WARRANTY

- A. Warrant Color throughout FRP Doors, Frames, and Factory Hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.
- B. Warranty Period: Ten (10) years starting at Substantial Completion. In addition, limited lifetime warranty covering the following: failure of corner joinery, core deterioration, delamination or bubbling of door skin.
- C. Factory Applied Hardware: The workmanship and materials involved with the installation of hardware by the door manufacturer is guaranteed to be free of defect for ten (10) years from the date of shipment. Door Manufacturer to install

all hardware, except door closers, and warrant attachment for indicated time. For warranty information of hardware operation, refer to Section 087100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Special-Lite, Inc., Decatur, Michigan.

2.2 FRP FLUSH DOORS

- A. Model: SL-17 Pebble Texture Flush Doors by Special-Lite
- B. Construction:
1. Door Thickness: 1-3/4 inches.
 2. Stiles and Rails: Aluminum Alloy 6063-T5, minimum of 2-5/16-inch depth.
 3. Corners: Single extrusion, mitered.
 4. Provide joinery of 3/8 inch diameter full width tie rods through extruded splines top and bottom as standard tubular shaped stiles and rails reinforced to accept hardware as specified.
 5. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
 6. Furnish extruded stiles and rails with integral door edge (reglets) to accept face sheets on all four sides. Lock face sheets into place to permit flush appearance. Door edge and internal frame to be one extrusion on all four sides.
 7. Door Edge: Integral to mitered internal frame. Screw applied or snap on edge caps or other face sheet capture methods are not acceptable. No visible fasteners unless required for hardware attachment.
 8. Extrude top and bottom rail legs for interlocking continuous weather bar.
 9. Adjustable Astragal for Pairs of Doors: Door Manufacturer to provide and install full height recessed spring-loaded dual brush adjustable astragal on active door to allow for seasonal adjustment against air infiltration.
 10. Concealed Adjustable Door Bottom: Supply SL-301 dual brush adjustable door bottom.
 11. Glue: Use of glue to bond sheet to core or extrusions is not acceptable.
 12. Hardware Reinforcement: Provide minimum 1/8-inch solid aluminum for all hardware attachment points. For door closers provide minimum 1/8-inch reinforcement on inside and outside faces of doors to accommodate possible through bolt attachment.

- C. Face Sheet for FRP PEBBLE TEXTURE Flush Doors:
 - 1. Material: SpecLite3 FRP, 0.120-inch thickness, finish color throughout. Exterior Grade Surface Sealed Abuse Resistant Engineered Surface for increased cleanability and graffiti resistance. Exterior Face Sheet of exterior doors to be Class C rated. Interior Face Sheets exterior doors to be Class A rated.
 - 2. Texture: Pebble.
 - 3. Color: Architect to select color from full range of manufacturer's standard color-thru selection.
- D. Core:
 - 1. Material: Poured in place polyurethane foam.
 - 2. Density: Minimum of 5 pounds per cubic foot.
 - 3. Foam Core "R" Value: Minimum of 9.1.
 - 4. Provide 0.032-inch aluminum liner between foam core and FRP face sheet per IBC 2603.4.1.7 if door has not passed independent testing.
 - 5. Use of glues to secure core is not acceptable.
- E. Cutouts:
 - 1. Manufacture Doors with cutouts for required vision lites, louvers, and panels.
 - 2. Factory install vision lites, louvers, and panels.
- F. Hardware:
 - 1. Pre-machine Doors in accordance with templates from specified hardware manufacturers and hardware schedule.
 - 2. Factory-install hardware except closers.

2.3 FIRE RATED FRP CLAD DOORS

- A. Special-Lite SL-21 Fire Rated Doors
 - 1. 45-, 60- or 90-minute fire-rated as indicated on Door Schedule.
 - 2. Thickness: 1-3/4-inches.
 - 3. Stile & Rails to be stainless steel channel with stainless steel screws every 10 inches.
 - 4. Corners: Welded.
 - 5. Face Sheets:
 - a. Exterior Face Sheets: SpecLite3, Class A (as required).
 - b. Interior Face Sheets: Class A.
 - c. Thickness: 0.120-inch.

- d. Finish color throughout. Color as selected by Architect.
 - e. Surface: Abuse-resistant pebble texture.
 - 6. Core Material: Mineral Core.
 - a. Mineral.
 - b. Density: Minimum 30 Pounds per cubic foot.
 - c. Perimeter Firestop: 1-1/2 inches wide, 82 to 84 pounds per cubic foot.
 - d. Screw Holding Requirement: 800 pounds screw holding.
 - 7. Cutouts: Manufacture doors with required cutouts for factory installed vision lites.
 - 8. Fasteners for Perimeter channel to be 18-8 stainless steel.
- B. Fire Rated Hollow Metal Frames: As specified and supplied in section 081113.
 - 1. Hardware shall be fire rated.
 - 2. Pre-machine doors in accordance with templates from specified hardware supplier.
 - 3. Factory install hardware except door closer, smoke, and intumescent gaskets.
 - 4. Door Manufacturer to supply smoke/draft and intumescent gasketing to meet positive pressure requirements
- C. Vision Lite: Manufactures standard Fire Rated Vision Lite.
 - 1. Factory Glazed: As indicated in Section 088000
 - 2. Size: As indicated on drawings within code requirements.
- D. Performance Requirements: 90 Minute Full-Scale Vertical Fire Test of Door, Positive Pressure.
 - 1. UBC Standard 7-2.
 - 2. NFPA 252- Fire Tests of Door Assemblies.
 - 3. UL 10C- Positive Pressure Fire Tests for Door Assemblies.
 - 4. ASTM E 84- Surface Burning Characteristics of Building Materials.
 - 5. ASTM D 2583- Indentation Hardness of Rigid Plastics by Means of Barcol Impressor.
 - 6. ASTM D 1308- Effect of Household Chemicals on Clear and Pigmented Finishes.
 - 7. ASTM D 638- Tensile Properties Plastics.
 - 8. ASTM D 570- Water Absorption of Plastics.
 - 9. ASTM D 256- Pendulum Impact Resistance of Notched Specimens of Plastic.
 - 10. ASTM D 790- Flexural Strength of Reinforced Plastics.

2.4 ALUMINUM COMPONENTS

- A. Aluminum Members: Produced from 100% reprocessed 6063-T5 alloy
 - 1. Extrusions: ASTM B 221.
 - 2. Sheet and Plate: ASTM B 209.
 - 3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of color.
- B. Components: Door and Frame components from same manufacturer.
- C. Fasteners:
 - 1. Material: Aluminum, 18-8 stainless steel or other non-corrosive metal.
 - 2. Compatibility: Compatible with items to be fastened.
 - 3. Exposed Fasteners: Screws with finish matching items to be fastened.

2.5 FABRICATION

- A. Sizes and Profiles: Required sizes for door and frame units, and profile requirements shall be as indicated.
- B. Coordination of Fabrication: Field measure before fabrication and show recorded measurements on shop drawings.
- C. Assembly:
 - 1. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
 - 2. Remove burrs from cut edges.
- D. Welding: Welding of doors or frames is not acceptable.
- E. Fit:
 - 1. Maintain continuity of line and accurate relation of planes and angles.
 - 2. Secure attachments and support at mechanical joints with hairline fit at contacting members.

2.6 ALUMINUM FRAMING SYSTEMS

- A. Tubular Framing:
 - 1. Size and Type: Supply thermally improved flush glaze system, 0.080 inch wall thickness, SL-450T-FG, 2" x 4-1/2" or of sized indicated.

2. Materials: Aluminum Alloy 6063-T5
3. Immediate Door Frame: Heavy wall, minimum 1/8" wall thickness of size required.
4. Applied Door Stops: 0.625 inch high, with screws and weather-stripping. Door stop shall incorporate pressure gasketing for weathering seal. Counterpunch fastener holes in door stop to preserve full metal thickness under fastener head. Snap on or blade stops are not acceptable. Provide 1/2-inch solid aluminum bar stock behind door stop at closer shoe attachment point.
5. Frame Members: Box type with four (4) enclosed sides. Open back framing is not acceptable.
6. Caulking: Caulk joints before assembling frame members.
7. Joints:
 - a. Secure joints with fasteners.
 - b. Provide hairline butt joint appearance.
8. Factory Fabrication: Factory-fabricate immediate door framing to ensure proper industry clearances around doors. Use of stick material is not acceptable.
9. Applied Stops: If required for transom, and borrowed lites and panels. Applied stops shall incorporate pressure gasketing for weathering seal.
10. Hardware:
 - a. Pre-machine and reinforce frame members for hardware in accordance with manufacturer's standards and hardware schedule.
 - b. Hardware Reinforcement: Provide minimum 1/8" solid aluminum at all hardware attachment points.
 - c. Factory install hardware.
11. Anchors:
 - a. Anchors appropriate for wall conditions to anchor framing to wall materials.
 - b. Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
 - c. Secure head and sill members of transom, side lites, and similar conditions.
12. Side Lites:
 - a. Factory-assemble side lites to greatest extent possible.
 - b. Mark frame assemblies according to location.

2.8 HARDWARE

- A. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.

- B. Factory-installed hardware.
- C. Hardware Schedule: As specified in Section 087100.

2.9 VISION LITES

- A. Factory Glazing: 1-inch glass insulated glass for exterior doors. Fire-rated glass in rated doors. See schedule for glass types.
- B. Lites in Exterior Doors: Allow for thermal expansion.
- C. Rectangular Lites:
 - 1. Size: As indicated by door types.
 - 2. Factory glazed with screw applied aluminum stops anodized to match perimeter Door rails.

2.10 ALUMINUM FINISHES

- A. Anodized Finish: Class I finish, 0.7 mils thick.
 - 1. Clear 215 R1, AA-M10C12C22A41, Class I, 0.7 mils thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.3 INSTALLATION

- A. Install Doors in accordance with manufacturer's instructions.
- B. Install Doors plumb, level, square, true to line, and without warp or rack.
- C. Anchor frames securely in place.

- D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by Architect.
- E. Set thresholds in bed of mastic and back seal.
- F. Install exterior Doors to be weather-tight in closed position.
- G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- H. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for installation of Doors.

3.5 ADJUSTING

- A. Adjust Doors, hinges, and locksets for smooth operation without binding.

3.6 CLEANING

- A. Clean Doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that damage finish.

3.7 PROTECTION

- A. Protect installed doors to ensure that, except for normal weathering, Doors shall be without damage or deterioration at time of Substantial Completion.

END OF SECTION 081733

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Access Panel Solutions.
 2. Babcock-Davis.
 3. JL Industries, Inc.; a division of the Activar Construction Products Group.
 4. Larsens Manufacturing Company.
 5. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 6. Nystrom, Inc.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Exposed Flanges in CMU:
1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 2. Locations: Wall and ceiling.
 3. Door Size: As indicated.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16-gage.
 - a. Finish: Factory prime, field paint.
 5. Toilet Rooms and Kitchen: Stainless-Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), @ 16-gage.
 - a. Finish: No. 4.
 6. Frame Material: Same material, thickness, and finish as door.
 7. Hinges: Manufacturer's standard.
 8. Hardware: Lock.
- D. Flush Access Doors with Concealed Flanges in GWB:
1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board or plaster beads per location for concealed flange installation.
 2. Locations: Wall and ceiling.
 3. Door Size: As indicated.
 4. Uncoated Steel Sheet for Door: Nominal 0.060-inch (1.52 mm), 16-gage.
 - a. Finish: Factory prime, field paint.
 5. Toilet Rooms and Kitchen: Stainless-Steel Sheet for Door: Nominal 0.062-inch (1.59 mm), 16-gage.
 - a. Finish: No. 4.
 6. Frame Material: Same material and thickness as door.

7. Hinges: Manufacturer's standard.
8. Hardware: Lock.

E. Fire-Rated, Flush Access Doors with Exposed Flanges in CMU:

1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Wall and ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of thirty (30) minutes.
5. Uncoated Steel Sheet for Door: Nominal 0.036-inch (0.91 mm), 20-gage.
 - a. Finish: Factory prime, field paint.
6. Toilet Rooms and Kitchen: Stainless-Steel Sheet for Door: Nominal 0.038-inch (0.95 mm), 20-gage.
 - a. Finish: No. 4.
7. Frame Material: Same material, thickness, and finish as door.
8. Hinges: Manufacturer's standard.
9. Hardware: Latch.

F. Fire-Rated, Flush Access Doors with Concealed Flanges in GWB:

1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide frame with gypsum board and plaster beads, depending on location, for concealed flange installation.
2. Locations: Wall and ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of thirty (30) minutes.
5. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20-gage.
 - a. Finish: Factory prime, field paint.
6. Frame Material: Same material, thickness, and finish as door.
7. Hinges: Manufacturer's standard.
8. Hardware: Lock.

G. Hardware:

1. Latch: Cam latch operated by flush key.
2. Lock: Cylinder, coordinate with hardware master keying.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines or blend into finish.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Steel and Metallic-Coated-Steel Finishes in all locations unless otherwise indicated:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Field finish paint.
- E. Stainless-Steel Finishes in Toilet Rooms, Kitchens, Custodian Closets
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

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SECTION 083300 – ROLLING COUNTER FIRE SHUTTERS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Electric-Operated Automatic Closing Rolling Counter Fire Doors with SmokeShield® Underwriter's Laboratories (UL) leakage rated assembly label.
- B. Related Sections:
 - 1. 055000 Metal Fabrications. Door opening jamb and head members.
 - 2. 061053 Miscellaneous Rough Carpentry. Door opening jamb and head members.
 - 3. 083113 Access Doors and Frames. Access doors.
 - 4. 087100 Hardware. Padlocks. Masterkeyed cylinder.
 - 5. 099100 Painting. Field painting.
 - 6. Division 26. Electrical wiring and conduit, fuses, disconnect switches, connection of operator to power supply, installation of control station and wiring, and connection to alarm system.
- C. Products That May Be Supplied, But Are Not Installed Under This Section:
 - 1. Control station.
 - 2. Electrical disconnect.
 - 3. Annunciators.
 - 4. Primary and control wiring.
 - 5. Conduit and fittings.

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Provide doors with UL label for the fire rating classification, 3/4 hour.
 - 2. Provide doors with UL label for "Leakage Rated Assembly" or "S" label demonstrating product tested to UL 1784.
 - a. Comply with NFPA 105 installation and maintenance requirements
 - 3. For counter fire doors up to 10' wide and 6' high, provide guides with integral and invisible guide brush seal.

1.3 SUBMITTALS

- A. Reference Section 013300 Submittal Procedures; submit the following items:

1. Product Data.
2. Shop Drawings:
 - a. Include special conditions not detailed in Product Data. Show interface with adjacent work.
3. Quality Assurance/Control Submittals:
 - a. Provide proof of manufacturer ISO 9001:2015 registration.
 - b. Provide proof of manufacturer and installer qualifications - see 1.4 below.
 - c. Provide manufacturer's installation instructions
 - d. Provide manufacturer's Health Product Declaration (HPD) for each product.
4. Closeout Submittals:
 - a. Operation and Maintenance Manual.
 - b. Certificate stating that installed materials comply with this specification.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer Qualifications:
 - a. ISO 9001:2015 registered with a minimum of five (5) years' experience in the manufacturing of counter fire doors and smoke control units of the specified type.
 2. Installer Qualifications:
 - a. Manufacturer's approval.

1.5 DELIVERY STORAGE AND HANDLING

- A. Reference Section 016000 - Product Requirements.
- B. Follow manufacturer's instructions.

1.6 WARRANTY

- A. Standard Warranty:
 1. Two (2) years from date of shipment against defects in material and workmanship.
- B. Maintenance:
 1. Submit for owner's consideration and acceptance of a maintenance service agreement for installed products.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Basis of Design: Model ERC10. Substitutions permitted only as allowed for products complying with the requirements and criteria of this specification.
 - 1. Cornell. 24 Elmwood Avenue, Mountain Top, PA 18707. T: (800) 233-8366.
 - 2. Cookson.
 - 3. Clopay Building Products.
 - 4. Approved equal.

2.2 MATERIALS

- A. Curtain:
 - 1. Slat Configuration:
 - a. Stainless Steel:
 - i) No. 1F, interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, minimum 22 gauge AISI type 304 #4 finish stainless steel with stainless steel bottom bar and vinyl astragal.
 - 2. Finish:
 - a. Stainless Steel: Type 304, #4 brushed finish.
- B. Endlocks:
 - 1. Fabricate continuous interlocking slat sections with high strength galvanized steel endlocks riveted to slats per listing requirements.
- C. Guides:
 - 1. Configuration & Finish:
 - a. Stainless Steel:
 - i) Minimum 12 gauge formed shapes
 - ii) Type 304 #4 brushed finish with matching stainless-steel fasteners.
- D. Counterbalance Shaft Assembly:
 - 1. Barrel:
 - a. Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.
 - 2. Spring Balance:
 - a. Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum

effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.

- E. Brackets:
Fabricate from reinforced steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - 1. Finish:
 - a. Powder Coat (Stock Colors):
 - i) Zirconium treatment followed by a white baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.
- F. Hood and Mechanism Covers:
24 gauge stainless steel with reinforced top and bottom edges. Provide minimum 1/4-inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.
 - 1. Finish:
 - a. Stainless steel:
 - i) Type 304 #4 brushed finish.

2.3 OPERATION

- A. Motor Operation:
 - 1. AlarmGard Advanced Tube Motor Operation:
 - a. UL listed NEMA 1 enclosure, 115v/ 60 Hz/ single phase service. Provide a totally enclosed non-ventilated motor, removable without affecting the setting of limit switches; thermal overload protection, planetary gear reduction, adjustable rotary limit switch mechanism and a transformer with 24v secondary output.
 - b. Provide a failsafe tubular motor operated fire shutter assembly requiring no ancillary or externally mounted release devices, cables, chains, pulleys, reset handles or mechanisms.
 - c. Provide an internal electrical failsafe release device that requires no additional wiring, external cables or mounting locations.
 - d. Provide an internal solenoid brake mechanism to hold the door at any position during normal door operation.
 - e. Control automatic closure speed with an internal, totally enclosed, variable rate centrifugal governor without the use of electrical

pulsation, constant rate viscosity, oscillation type or other exposed governing devices.

- f. Electrically activate door system automatic closure by notification from central alarm system.
- g. Maintain automatic closure speed at not more than 12" (229 mm) per second.
- h. Enable safety edge function during alarm gravity closing while power is present Enable door to rest upon obstruction following this sequence.
- i. Electrically reset internal failsafe release device and door operating system upon restoration of electrical power and upon clearing of the alarm signal without requiring human supervision.
- j. Provide selectable ability for the door system to automatically self-cycle to the fully open position following automatic reset without requiring human supervision.
- k. Ensure that manual resetting of spring tension, release devices, linkages or mechanical dropouts will not be required.
- l. Notify electrical contractor to mount control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the door system wiring instructions.
- m. Drop test and reset door system twice by all means of activation and comply fully with NFPA 80 Section 5.

C. Control Station:

- 1. Surface mounted: "Open/Close/Stop" push buttons; NEMA 1.

D. Control Station Operation:

- 1. Constant pressure to close:
 - a. No entrapment protection device required.

2.4 ACCESSORIES

A. Locking:

- 1. None.
- 2. Stainless steel min. 14 gauge type 304 #4 finish:
 - a. 1 ½ Hour UL Labeled, 2" (51 mm) thick, 14 gauge type 304 #4 finish stainless steel. Rectangular shape design for between jambs mounted unit of size and configuration for opening size and wall construction.

B. Battery Backup:

1. Model R-BBU Battery Back-Up System:
 - a. For AlarmGard Motor Operator to provide a minimum of six hours door hold-open time in the event of a power failure.
- C. Operator and Full Bracket Mechanism Cover:
 1. 24 gauge stainless steel sheet metal cover to enclose exposed moving operating components at coil area of unit. Finish to match door hood.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

- A. Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.

3.3 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 FIELD QUALITY CONTROL

- A. Site Test: Test doors for normal operation and automatic closing. Coordinate with authorities having jurisdiction to witness test and sign Drop Test Form.

3.5 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

3.6 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Representative.
- B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION 083300

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior storefront framing.
 - 2. Storefront framing for window walls.
 - 3. Storefront framing for punched openings.
 - 4. Venting units.
 - 5. Exterior and interior manual-swing entrance doors.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - C. Samples for Initial Selection: For units with factory-applied color finishes.
 1. Flashing and drainage.
 - D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing, fabrication, and assembly of entrance door hardware, as well as procedures and diagrams. 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.
 - E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
 - B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
 - C. Sample Warranties: For special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
 - B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Ten (10) years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4-inch (19.1 mm), whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8-inch (3.2 mm).
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
- E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12.0 lbf/sq. ft.
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

- I. Energy Performance: Certify and label energy performance according to NFRC as follows:
 - 1. **Thermal Transmittance (U-factor):** Fixed glazing and framing areas shall have U-factor of not more than 0.36 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 - 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURERS

- A. Framing System Type 1: Basis of Design Product: Subject to compliance with requirements, provide EFCO Corporation; Series 402T.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing venting windows and accessories, from single manufacturer.

2.3 TYPE 1 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally-broken and Thermally-improved.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: Front.
 - 4. Finish: High-performance organic finish.
 - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.
- D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 RIBBON STOREFRONT WINDOW SYSTEM

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Thermally-broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
 4. Finish: High-performance organic finish.
 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.
- D. Materials:
 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods

according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

- a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
- b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
- c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.5 ENTRANCE DOOR SYSTEMS

- A. Aluminum Door Type 1: Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Corporation; Series D518.
 2. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 3. Door Design: Wide stile; 5-inch (127-mm) 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.
- B. Aluminum Door Type 2: Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Corporation; Series D200.
 2. Door Construction: 1 3/4-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.
 3. Door Design: Narrow stile; 2 1/8 -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.

2.6 VENTING WINDOWS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Corp.; System WV410.
- B. Aluminum Windows: AAMA/WDMA/CSA 101/I.S.2/A440, manufacturer's standard, with self-flashing mounting fins, and as follows:

1. Window Type: Casement.
2. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 0.064-inch (1.63-mm) thickness at any location for main frame and sash members.
3. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
 - a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch (3.26 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
4. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze:

2.7 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. Weather Stripping: Manufacturer's standard replaceable components.
 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- D. Silencers: BHMA A156.16, Grade 1.

2.8 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L.

- E. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.

- 1. Color: Clear. Use in Butt Glazed interior aluminum framed system.

2.9 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

- 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

- 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.10 FABRICATION

- A. Form or extrude aluminum shapes before finishing.

- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

- C. Fabricate components that, when assembled, have the following characteristics:

- 1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from exterior.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using screw-spline system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- 2.11 ALUMINUM FINISHES
- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color: Black all locations.
- B. High-Performance Organic Finish: Mica fluoropolymer.
1. Location: Exterior openings.

2. Color: As selected by Architect's from manufacturer's range.

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 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.

- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Sections 088000 "Glazing" and 088853 "Security Glazing".
- G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
 - 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 085653 – SECURITY WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, transaction security windows and glazing.
- B. Related Requirements:
 - 1. Section 099100 "Painting" for field painting security windows.

1.3 COORDINATION

- A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, weights and finishes for window units.
- B. Shop Drawings: For security windows.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
 - 3. Hardware for sliding window units.
 - 4. Glazing details.
 - 5. Details of deal tray and speaking aperture.
- C. Samples for Initial Selection: For frame members with factory-applied color finishes.

- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Framing: 12-inch long sections of frame members.
- E. Cutaway Sample: Corner of security window, made from 12-inch lengths of full-size components, and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Glazing.
 - 4. Deal tray section.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Test Reports: For each type of security window and accessory indicated as ballistics or forced-entry resistant, for tests performed by a qualified testing agency.
- D. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F1233.
- E. Examination reports documenting inspections of substrates, areas, and conditions.
- F. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- G. Field quality-control reports documenting inspections of installed products.
 - 1. Field quality-control certification signed by Contractor.
- H. Sample Warranty: For special warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label security window packaging with drawing designation.
- C. Store crated security windows on raised blocks to prevent moisture damage.

1.9 FIELD CONDITIONS

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

1.10 SEQUENCING

- A. Field Painting (if applicable): Except where security windows have been pre-glazed before installation, complete field painting of security windows before glazing installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including deflections exceeding 1/4 inch.
 - b. Failure of welds.
 - c. Excessive air leakage.
 - d. Faulty operation of sliding window hardware.
 - e. Faulty operation of speaking aperture.
 - f. Faulty operation of deal tray flip cover.
 - g. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
 - 1. Ballistics Resistance: Level 4 when tested according to UL 752.
 - 2. Forced-Entry Resistance: Class III when tested according to ASTM F1233.
 - 3. Forced-Entry Resistance: 15 minute protection level when tested according to SD-STD-01.01.

- B. Air Infiltration: Provide windows with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.

2.2 FIXED, TRANSACTION SECURITY WINDOWS

- A. Provide fixed, transaction security windows with voice aperture and operable deal tray capable of allowing transfer of currency and documents.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide aluminum Exterior Transaction Window by Total Security Solutions, or a comparable product by one of the following:
 - a. Armortex, Inc.
 - b. C.R. Laurence Co., Inc.
 - c. Chicago Bullet Proof Systems.
 - d. Diebold, Incorporated
 - e. Krieger Specialty Products Company.
 - f. Laurance, C.R. Company, Inc.
 - g. Quikserv Corp.
 - h. Ready Access.
- B. Configuration: One fixed-glazed panel.
- C. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide BL 5.5 Ballistic Framing by Total Security Solutions.
 - 2. Profile: Manufacturer's standard with minimum face dimension of 1-3/4 inches.
 - 3. Depth: Manufacturer's standard, minimum 5-1/2 inches.
 - 4. Opening Size: As indicated on drawings.
 - 5. Head and Jamb Framing: Bullet resistant aluminum and designed for sealant glazing to meet ballistics and forced entry requirements.
- D. Channel-Frame Sill: Designed for sealant glazing.
- E. Transaction Counter: Stainless steel, minimum 12 inches deep by width of security window, with integral deal tray with flip cover, centered in opening.
- F. Voice Transmission: Stainless steel, 6" diameter speaking aperture.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide MK-1 Voice Port by Total Security Solutions.
- G. Glazing Assembly: To meet ballistics and forced entry requirements.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Glass-Clad Polycarbonate, No Spall, Bullet Resistant, Level 4 Glazing by Total Security Solutions.

2. Glazing Components: Overall Thickness 1 1/8 inch average.
 - a. Threat Side Layer 1 - Glazing: 3/8 inch Clear Glass
 - b. Threat Side Layer 2 – Coating: 0.05 Urethane
 - c. Interlayer Layer - Glazing: 3/8 inch Clear Glass
 - d. Secure Side Layer 1- Coating: 0.070 Urethane
 - e. Secure Side Layer 2- Glazing: 1/4 inch Mar Resistant Clear Polycarbonate
- H. Glazing Materials: Additional requirements comply with manufacturer's recommendations and Section 088853 "Security Glazing."
- I. Glazing Meeting Edges: Polished glazing.
- J. Materials:
 1. Mild Steel Plates, Shapes, and Bars: ASTM A36/A36M.
 2. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.
 3. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
 4. Aluminum Sheet and Plate: ASTM B209.

2.3 FABRICATION

- A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
 1. Provide units that are re-glazable from the secure side without dismantling the attack side of framing.
 2. Prepare security windows for field glazing unless pre-glazing at the factory is indicated.
- B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.
- C. Thermally Improved or Thermally Broken Construction: Fabricate framing with an integral, concealed, low-conductance thermal barrier, located between exterior materials and members exposed on interior in a manner that eliminates direct metal-to-metal contact.
- D. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
 1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.
- E. Glazing Stops: Finish glazing stops to match security window framing.
 1. Threat-Side (Exterior) Glazing Stops: Welded or integral to framing.

2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
- F. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- G. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- H. Factory-cut openings in glazing for speaking apertures.
- I. Pre-glazed Fabrication: Pre-glaze window units at factory, where required for applications indicated. Installation orientation of glazing to meet performance requirements.
- J. Weather Stripping: Factory applied.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

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

2.6 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 1. Run grain of directional finishes with long dimension of each piece.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 3. Directional Satin Finish: No. 4.

2.7 ACCESSORIES

- A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.
- B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A27/A27M cast steel or ASTM A47/A47M malleable iron. Provide bolts, washers, and shims as required; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.
- C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch diameter, headed studs welded to back of plate.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- E. Glazing Strips and Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Molded EPDM or neoprene gaskets complying with ASTM D2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C509, Grade 4.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric backing.
- F. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.
 - 1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
 - 2. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
 - 3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - 4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- G. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B633; provide sufficient strength to withstand design pressures indicated.

- H. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking, and nonmigrating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.
- D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
 - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
 - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For factory-installed glazing materials whose orientation (secure or attack side) is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.
 - 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
 - 1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same forced-entry-resistance and ballistics-resistance performance as security window.

- B. Glazed Framing: Provide sealant glazed framing.
- C. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.
- E. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
- F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.5 ADJUSTING

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

3.6 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
 - 1. Lubricate sliding security window hardware.

2. Lubricate transaction drawer hardware.

- B. Clean glass of pre-glazed security windows promptly after installation. Comply with cleaning and maintenance requirements in Section 088000 "Glazing" and Section 088853 "Security Glazing."
- C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain operable security windows, speaking apertures, and voice transmission devices.

END OF SECTION 085653

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. 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. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 06 Section "Rough Carpentry".
 - 2. Division 08 Section "Hollow Metal Doors and Frames".
 - 3. Division 08 Section "Flush Wood Doors".
 - 4. Division 08 Section "Fiberglass Doors".
- D. Codes and References: Comply with the version year 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. State Building Codes, Local Amendments.

- E. Standards: All hardware specified herein shall comply with the following industry standards:
1. ANSI/BHMA Certified Product Standards – A156 Series.
 2. UL10C – Positive Pressure Fire Tests of Door Assemblies.

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.
- F. 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 Submittals.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum five (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. Installer Qualifications: A minimum three (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.

- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum five (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.
- D. 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.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. 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.
- G. 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.

- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 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".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 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. Standard Warranty Period: One (1) year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten (10) years for mortise locks and latches.
 - 2. Five (5) years for exit hardware.
 - 3. Twenty-five (25) years for manual surface door closer bodies.
 - 4. Two (2) years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

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

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 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. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
 - b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
 - c. Stanley Hardware (ST).

2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
 - 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 Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 certified 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 Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum ten (10) years' experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 - 4. 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.
 - 5. Keyway: Match Facility Standard.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with Owner having the ability for on-site original key cutting.
 - 1. Manufacturers:

- a. Medeco (MC) - X4 Series.
 - b. No Substitution.
 - F. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Conduct specified "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: Key locks to Owner's existing system.
 - G. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Three (3).
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
 - 4. Construction Control Keys (where required): Two (2).
 - 5. Permanent Control Keys (where required): Two (2).
 - H. Construction Keying: Provide temporary keyed construction cores.
 - I. 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.
- 2.5 MECHANICAL LOCKS AND LATCHING DEVICES
- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 - 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) – ML2000 Series.
 - b. No Substitution.
- 2.6 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: HMA 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.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 10. 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 panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
 - a. Stanley Precision (PR) - Apex 2000 Series.
 - b. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - c. Sargent Manufacturing (SA) - 80 Series.

2.8 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 including installation and adjusting information on inside of cover.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper

installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 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. Manufacturers:
 - a. Stanley Precision (ST) – QDC100 Series.
 - b. Sargent Manufacturing (SA) - 351 Series.
 - c. Norton Door Controls (NO) - 7500 Series.

2.9 ARCHITECTURAL TRIM

- A. Door Protective Trim
 - 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 - 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 - 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 - 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.
 - 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
 - 6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).

2.10 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified 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 Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified 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. Rixson Door Controls (RF).
 - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - c. Sargent Manufacturing (SA).

2.11 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 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 Products; ASSA ABLOY Architectural Door Accessories (PE).
 3. Reese Enterprises, Inc. (RE).

2.12 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.

2.13 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 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. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

- E. 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: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

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.

- B. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.
- C. Manufacturer's Abbreviations:
 - 1. RO – Rockwood.
 - 2. RU - Corbin Russwin.
 - 3. SA – Sargent.
 - 4. MC – Medeco.
 - 5. RF – Rixson.
 - 6. PE – Pemko.

Hardware Sets: Provided as part of Bid Addendum 1.

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Storefront framing.
 - 3. Glazed entrances.
 - 4. Glazed interior walls.
 - 5. Borrowed lites.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Provide glazing that meets the minimum requirements of the NYS Building Code §2406.1 Human Impact Loads. Individual glazed areas, including glass mirrors, in hazardous locations as defined in §2406.2 shall pass the test requirements of CPSC 16 CFR 1201, listed in Chapter 35. Glazing shall comply with the CPSC 16 CFR, Part 1201 criteria for Category I or Category II as indicated in Table 2406.1.
 - 1. All glass units over 9 square feet in size shall be Category II safety glass.
- B. General: Installed glazing systems shall withstand normal thermal movement and wind

and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- C. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified **NYS licensed professional engineer**, using the following design criteria. Design to be signed and sealed and certified to be in compliance with the building code of NYS and as specified.

Safety Glazing Products: Comply with testing requirements in 16 CFR 1201

1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: 90 mph.
2. Design Snow Loads: As indicated on Drawings.
3. 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.
4. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
5. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
6. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
7. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 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.

2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

1.6 ACTION 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 square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-e coatings.
- B. Product Certificates: For glass and glazing products, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass coated glass insulating glass glazing sealants and glazing gaskets.
 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- G. 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. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.9 DELIVERY, STORAGE, AND HANDLING

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

1.10 PROJECT CONDITIONS

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

causes.

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

1.11 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: Ten (10) years from date of Substantial Completion.

- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

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

- C. 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: Ten (10)0 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.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm, except laminated units.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: 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. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 4. 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.
 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

- A. Kind FT (Fully tempered) float glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class 1, Condition A.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 - a. Heat Treated Flat Glass to be by horizontal (roller hearth) process with inherent roller-wave distortion parallel to the bottom edge of the glass as installed.
 - b. Maximum peak to valley roller-wave 0.003" (0.08 mm) in the central area and 0.008" (0.20mm) within 10.5" (267mm) of the leading and trailing edge.
 - c. Maximum bow and warp 1/32" per lineal foot (0.79 mm).
 - d. All tempered architectural safety glass shall conform with ANSI Z97.1 and CPSC 16 CFR 1201.
 2. Labeled glass: Permanently label glass per ASTM standard for tempered glass (sand-blasted or etched graphic).
 3. Thickness: As indicated on drawings, or 3/8-inch otherwise.
 4. Type Tempered: Clear, 1/4-inch.

2.3 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions. Fabricate with tempered glass.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.
 - 4. Type Laminated: 1/4-inch thick.

2.4 SPANDREL Glass

- A. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.
 - 1. Glass: Clear float.
 - 2. Ceramic Coating Color: As selected by Architect from manufacturer's full range.

2.5 INSULATING GLASS

- A. Basis of Design Manufacture for glass used to fabricate insulated units: Guardian Industries Inc.
- 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: Manufacturer's standard spacer material and construction.
 - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.6 GLAZING GASKETS

- A. 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.

- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, 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.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

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. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 4. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.

- f. Tremco Incorporated; Spectrem 1.
- g. Insert manufacturer's name; product name or designation.

2.8 MISCELLANEOUS GLAZING MATERIALS/ACCESSORIES

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

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.10 INSULATING-GLASS TYPES

- A. Low-e-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Outdoor Lite: Clear, heat strengthened, fully tempered, float glass; 6 mm.
 - 3. Interspace Content: Air.
 - 4. Indoor Lite: Clear, heat strengthened, fully tempered, float glass, 6 mm.
 - 5. Low-E Coating: Guardian SuperNeutral SNX 62/27 on second surface.
 - 6. Visible Light Transmittance: 62 percent minimum.
 - 7. Winter Nighttime U-Factor: 0.29 maximum.
 - 8. Solar Heat Gain Coefficient: 0.27 maximum.
 - 9. Provide safety glazing labeling.
- B. Clear insulating glass:
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Outdoor Lite: Clear, heat strengthened, fully tempered, float glass, 6mm.
 - 3. Interspace Content: Air.
 - 4. Indoor Lite: Clear, heat strengthened, fully tempered, float glass, 6mm.
 - 5. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. 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.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- 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.

- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

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

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

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

3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 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 meet 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.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088700 – SECURITY GLAZING FILMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Security Glazing film applied to existing glazing assemblies.

1.3 CODES AND REFERENCES:

- A. FTD SA – Filti Testing and Development Shooter Attack Certification.
- B. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Consumer Products Safety Commission; current edition.
- C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- D. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of security glazing films with minimum five (5) years' successful experience with the exact product specified.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
- C. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Record of product certification for safety requirements.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- D. Samples: For each film product to be used, minimum size 4 inches by 6 inches, representing actual product, color, and patterns.
- E. Specimen warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufactures unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent—based materials, in accordance with requirements of authorities having jurisdiction.

1.7 FIELD 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 absolute limits.

1.8 WARRANTY

- A. Provide a fifteen (15) year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S

- A. Basis of Design: Armoured One, LLC., 386 North Midler Avenue, Syracuse, NY 13206. Tel: 315-720-4186; Email: info@armouredone.com; Web: www.armouredone.com.

2.2 MATERIALS

A. Security Glazing Film:

1. Transparent polyester film for permanent bonding to glass.
2. Final installed product must be a minimum of 0.023 inches (23 Mil) thick.
 - a. Installing multiple layers of thinner film to accomplish the required thickness is not allowed.
3. Adhesive Type: Pressure sensitive.
4. FTD SA – Standard for Shooter Attack certification, Class 1 (tested on ¼" tempered glass).
5. Tensile Strength: ASTM D-882, 35,000 psi minimum.
6. Breaking Strength: ASTM D-882, 640 lbs. / inch.
7. Elongation at Break: ASTM D-882, 230%
8. Haze: ASTM D1003, <4%
9. Color b: ASTM D2244, 4.2
10. Visible Light Transmission: 87%
11. Visible Light Reflected (Int): 12%
12. Visible Light Reflected (Ext): 12%
13. UV Block:>99%
14. Total Solar Energy Reflected: 11%
15. Total Solar Energy Transmitted: 77%

16. Total Solar Energy Absorbed: 12%
 17. Shading Coefficient: 0.93
 18. Total Solar Energy Rejected: 19%
 19. Solar Heat Gain Coefficient: 0.81
 20. U-Value Winter: 1.03
 21. K-Value Winter: 5.85
 22. Glare Reduction: 3%
 23. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
- B. Retrofit existing glazing assemblies to provide impact resistance and forced/attack resistance complying with FTD-SA-C1, ANSI Z97.1 and CPSC 16 CFR 1201 Category II.
- C. Anchoring System:
1. Per manufacturer's recommendations for the application.
 2. Provide supplemental anchoring system as required.

PART 2 - EXECUTION

3.1 EXAMINATION

- A. Field-Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames, ensure that existing conditions are adequate for proper application and Performance of film.

- C. Verify glass is not cracked, chipped, broken, or damaged.
- D. Verify that frames are securely anchored and free of defects.

3.2 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- C. Protect adjacent surfaces.
- D. Do not begin installation until substrates have been properly prepared.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- B. Seams. Seam film only as required to accommodate material sizes; seam without overlaps. Bring to the attention of the architect and owner prior to proceeding where seams are required.
- C. Clean glass and excess structural sealants from finished surfaces
- D. Remove any labels or protective covers.

3.4 FILM VERIFICATION

- A. Awarded contractor will be required to verify that film installed meets the requirements highlighted in this bid. By submitting a bid, you as the contractor understand that three pieces of glass, chosen at random will be removed and film applied will be measured to verify that film installed meets specifications as

requested. Film may need to be removed as part of the verification process.

3.5 PROTECTION

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

END OF SECTION 088700

SECTION 088813 - FIRE-PROTECTIVE RATED GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection-rated glazing.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product; 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers and glass testing agency.
- B. Product Certificates: For each type of glass and glazing product, from manufacturer.
- C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

- A. Manufacturer's Special Warranty on Double Glazing Units with Clear Gel Fill: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of double glazing units with clear gel fill is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is the leakage of gel fill from units, air bubbles within units, or obstruction of vision by contamination or deterioration of gel.

- 1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PERFORMANCE REQUIREMENTS

- A. Provide glazing that meets the minimum requirements of the NYS building code §2406.1 Human impact loads. Individual glazed areas, including glass mirrors, in hazardous locations as defined in §2406.2 shall pass the test requirements of CPSC 16 CFR 1201, listed in Chapter 35. Glazing shall comply with the CPSC 16 CFR, Part 1201 criteria for Category I or Category II as indicated in Table 2406.2(1).

- 1. All glass units over nine (9) square feet in size shall be Category II safety glass.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
- B. Safety Glazing Labeling: Permanently mark glazing with certification label of the Safety Glazing Certification Council. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies. CPSC Cat. II required.

2.4 GLASS PRODUCTS

- A. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.
- B. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing: shall be tested in accordance with ASTM E119 or UL 263 and shall be labeled in accordance with table 716.3 of the NYS Building Code, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.
 - 1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.
- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.
- C. Double Glazing Units with Clear Gel Fill: Double glazing units made from two lites of uncoated, fully-tempered, ultraclear float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent gel; and complying with CPSC 16 CFR 1201, Category II.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide SAFTI FIRST Fire Rated Glazing Solutions; SuperLite II-XL or equal.
 - 2. Glass rating as indicated in Door Schedule.
 - 3. Color: Clear.

- D. Fully tempered, partial radiant heat protection; complying with CPSC 16 CFR 1201, Category II.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide SAFTI First Fire Rated Glazing Solutions; SuperLite I-XL.
 - 2. Glass rating: 20-minute, for use in all fire-resistance rated doors.
 - 3. Color: Clear.

2.6 GLAZING ACCESSORIES

- A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
 - 1. Sealants shall have a VOC content of 250 g/L or less.
 - 2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- C. 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 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written

instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 GLAZING, GENERAL

- A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.
- B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

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

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- 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.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

- B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

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

3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove non-permanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088813

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SECTION 088853 – SECURITY GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes
 - 1. Shooter Attack Certified Security Glazing

1.3 CODES AND REFERENCES:

- A. FTD-SA – Filti Testing and Development, Standard for Shooter Attack certification.
- B. 16 CFR 1201 – Safety Standard for Architectural Glazing Materials; Consumer Products Commission; current edition.
- C. ANSI Z97.1 – American National Standard for Safety Glazing Materials Used in Building, Safety Performance Specifications and Methods of Test; 2010.
- D. ASTM C 1036-06 – Standard Specification for Flat Glass
- E. State Building Codes, Local Amendments.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Provide glazing systems produced by a manufacturer with not less than 5-years successful experience in the fabrication of assemblies of the type and quality required.
- B. Installer's Qualifications: Glazed systems shall be installed by a firm that has not less than 5-years successful experience in the installation of systems like those required.
- C. Source Limitations for Glass: Obtain all glass products from a single manufacturer.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified independent agency.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: Manufacturers data sheets of each product to be used, including:
 - 1. Preparation instructions and recommendation
 - 2. Storage and handling requirements and recommendations
 - 3. Installation methods.
- C. Glazing Schedule:
 - 1. Use same designations indicated on Drawings.
 - 2. Listing types and thicknesses for each size, opening and location.
 - 3. Samples:
 - a. Submit one (1) 12-inch x 12-inch sample of each glass type specified.
 - b. Submit one (1) sample of each glazing sealant and/or glazing tape for color review.
 - 4. Warranty: Warranty documents specified herein.
- D. Certifications:

1. Certification that all sealants are fully compatible with the surfaces and finishes with which they are in applied.
2. Certification that all products comply with the test methods listed under Paragraph 1.3 Codes and References.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's unopened and undamaged packaging, with manufacturer's labels intact.
- B. Protect glass and glazing materials from damage in ordinance with manufacturer's recommendations.

1.7 WARRANTIES

- C. Non-Rated Glass Units: Warrant for ten (10) years from date of Delivery to be free from delamination and failure of seals and not to develop material obstruction of vision, as a result of dust, moisture, or film formation on internal glass surfaces.
- D. Glazing Sealants: Warrant for ten (10) years per sealant manufacturer's standard warranty of merchantable quality. Warranty shall certify that cured sealants:
 1. Will perform as a watertight weather-seal.
 2. Will not become brittle or crack due to weathering or normal expansion and contraction of adjacent surfaces.
 3. Will not harden beyond a Shore A durometer of 50, nor soften below a durometer of 10.
 4. Will not change color when used with compatible back-up materials.
 5. Will not bleed.

PART 2– PRODUCTS

2.1 MANUFACTURER'S

- A. Acceptable Manufacturer: Armoured One, LLC., 386 North Midler Avenue, Syracuse, NY 13206.
Tel: 315-720-4186; Email: info@armouredone.com; Web: www.armouredone.com.
- B. Substitutions: Not Permitted.

- C. Requests for substitutions will be considered in accordance with provisions in Division 01.

2.2 MATERIALS

- A. Shooter/Attack Resistant Security Glass, Non-Rated: AOTSG516.

1. Thickness: 5/16-inch.
2. FTD-SA – Standard for Shooter Attack certification Class 6.
3. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Consumer Products Safety Commission; current edition.
4. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.

- B. GLAZING MATERIAL

1. General: Comply with manufacturer's recommendations for applications and conditions at time of installation.
2. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
3. Setting Blocks: Neoprene, silicone, or EPDM, 70-90 durometer hardness, with proven compatibility with glazing materials used.
4. Spacers: Neoprene, silicone, or EPDM, 40-50 durometer hardness with proven compatibility with glazing materials used.
5. Compressible Fillers: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

- C. FABRICATION

1. Cut glass to full fit and play, consistent with glass and glazing material manufacturers' recommendations and the requirements of the Drawings and References, Codes and Standards Article.
2. Follow code requirements and glass manufacturer's recommendations for minimum bite and edge and face clearances.

3. Cut lights to smooth straight edges, clean, free of nicks and flares; nipping not permitted. Follow glass manufacturer's directions exactly for tinted and Low-E glass.
4. Glass Identification:
 - a. Manufacturer's and UL identifications for glazing shall be permanently etched to be visible after glass has been set in place and glazed.

PART 3 - EXECUTION

3.2 GENERAL

- A. Each glazing installation must withstand normal temperature changes, and impact loading without failure of glass, failure of sealants or gaskets, deterioration of glazing materials and other defects in the work.
- B. Protect glass from damage during handling and installation, and subsequent operation of glazed components of the work. Discard units with edge damage or other imperfections.
- C. Glazing channel dimensions are intended to provide for necessary bite on glass, minimum edge clearance, and adequate tape or sealant thicknesses, with reasonable tolerances.
- D. Comply with recommendations by manufacturers of glass and glazing products, except where more stringent requirements are indicated, including those of referenced glazing standards.

3.3 PREPARATION

- A. Clean glazing channel and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrate.
- B. Where sealants are used, apply primer or sealant to joint surfaces where recommended by sealant manufacturer.

3.4 INSTALLATION

- A. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
- B. Where sealants are used at butt joints, apply sealant in thin continuous clear bead. Tool sealant to a uniform, continuous, even profile.

- C. Apply glazing stops and clean up any excess structural sealants from finished surfaces.
- D. Conform to recommendations of glass manufacturer where such covers points not shown on Drawings or specified herein.
- E. Remove "loose" stops furnished with the units and reinstall as a part of the glazing operation.
- F. Handle glass so as to prevent nicks and flares on glass edges.
- G. Install glass exceeding 1/8" thickness on identical setting blocks permanently mounted and centered at 1/4 points. If necessary to reduce deflection of horizontal supporting member, blocks may be placed at 1/8 points or with the nearest end 6" (whichever is greater) from edge of glass unit. Ensure that blocks are equidistant from centerline of glass. Do not obstruct weep holes.
- H. Provide permanently mounted edge blocks at head and jambs of dry-glazed lights to prevent damage to glass edges during installation and lateral shifting of glass due to thermal and seismic loads and vibrations. Follow recommendations of Flat Glass Marketing Assn. Glazing Manual.
- I. Set glass to maintain bite, edge and face clearance stipulated by code and the glass manufacturer.
- J. Take special precautions to protect laminated glass edges from deterioration of vinyl interlayer by moisture.
- K. Glaze dry-glazed aluminum doors and frames as per manufacturer's directions using glazing gaskets and seals furnished with the units.
- L. Miter gaskets at corners and install so as to prevent pulling away at corners. Gaskets with gaps or other visible irregularities on door and window units shall be corrected by manufacturer or fabricator at no additional cost to University.

3.5 PROTECTION AND CLEANING

- A. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during construction period, including natural causes, accidents, and vandalism.
- B. Wash and polish glass on both faces, not more than 4 days prior to date scheduled for inspections intended to establish Date of Substantial Completion in each area of project. Comply with glass manufacturer's recommendations for final cleaning.

END OF SECTION 088853

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum and/or formed-metal louvers.

1.3 DEFINITIONS

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

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

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain 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. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without

permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. 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:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc.; Model A4097.
 2. Louver Depth: 4 inches (100 mm).
 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
 4. Mullion Type: Exposed.
 5. Finish: As selected by Architect from manufacturer's full range.
 6. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- B. Vertical, Storm Resistant Louver:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties; Model RS-5605.
 2. Louver Depth: 5 inches..
 3. Frame and Blade Nominal Thickness: 0.125 inch.
 4. Finish: As selected by Architect from manufacturer's full range.
 5. Louver Performance Ratings:
 - a. Free Area: Not less than 9.0 sq. ft. for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening except where insect screening is indicated.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Extruded-aluminum.
 - 2. Finish: Mill finish.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Flattened, expanded aluminum, 5/8 by 0.050 inch thick.
Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire or Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

2.5 BLANK-OFF PANELS

- A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: 2 inch.
 - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
 - 3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
 - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch (2.03-mm) nominal thickness, with corners mitered and with same finish as panels.
 - 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - 6. Panel Finish: Same type of finish applied to louvers.
 - 7. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-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.
- C. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 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. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. 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.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
1. 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.
- F. Provide subsills made of same material as louvers for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Custom Color to match metal wall panels. Metal wall panel basis of design is MBCI, colors are either MBCI Silver Metallic or MBCI Aegean Blue, depending on location.

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

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SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

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: Gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products 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, and 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 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.
- C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - 1. Depth: 2-1/2 inches (64 mm).
 - 2. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm) (20 gage).
- D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
- E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
- F. Room-Side Finish: As indicated.
- G. Shaft-Side Finish: Gypsum shaftliner board, moisture- and mold-resistant Type X.
- H. Insulation: Sound attenuation blankets.

2.3 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.

1. Products: Subject to compliance with requirements, provide the following:
 - a. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
2. Thickness: 1 inch (25.4 mm).
3. Long Edges: Double bevel.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

C. Gypsum Board: As specified in Section 092900 "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 1. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain,

without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.

- E. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."
- F. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8-inch (3 mm) from the plane formed by faces of adjacent framing.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 092116.23

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SECTION 092216 – NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Cast-in-place anchor, designed for attachment to concrete forms; postinstalled, chemical anchor; and post installed, expansion anchor.
 - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 2 inches.
- F. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538 inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 18 Gauge (0.0403 inch).
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 20 Gauge (0.0359 inch).
 - 4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- G. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Armstrong World Industries, Inc.; Drywall Grid Systems.
- b. Chicago Metallic Corporation; Drywall Furring System.
- c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 18 Gauge (0.0403 inch).
 - 2. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction-fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Steel Network Inc. (The); VertiClip SLD and/or VertiTrack VTD Series.
 - 2) Superior Metal Trim; Superior Flex Track System (SFT).
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - b. Metal-Lite, Inc.; The System.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 20 Gauge (0.0359 inch).

- E. Cold-Rolled Channel Bridging: 0.0538 inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 20 Gauge (0.0359 inch).
 - 2. Depth: 7/8-inch.
- G. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or hat shaped.
- H. Cold-Rolled Furring Channels: 0.0538 inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 3/4-inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 20 Gauge (0.0359) inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch- diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 24 Gauge (0.0239 inch), and depth required to fit insulation thickness indicated. Provide custom sized furring in 1/2", 3/4" or 1" sizes to meet specific assembly thicknesses shown on details in the contract documents.
- J. Stud Wall Reinforcing Steel (Tube and Base Plate):
 - 1. Provide heavy gauge steel manufactured product for reinforcing:
 - a. Low walls of metal framing that are 3'-0" to 6'-0" in height.
 - b. Metal framing at door jambs and strikes.
 - 2. Steel base plate metal thickness: 3/8-inch.
 - 3. Steel base plate dimensions: 3 inches x 8 inches with three holes for 1/2-inch diameter bolts.
 - 4. Size of vertical steel tube: 2-inch x 1-inch x 14 Gauge steel tube.
 - 5. Height of vertical steel tube: 34-1/2 inches.
 - 6. Vertical steel tube location on plate: Tube is at one end of base plate to brace low wall and offset on plate to allow conduits to pass by within reinforced low wall.
 - 7. Spacing for 3 ft high low wall: 6 feet on center.
 - 8. Spacing for 4 ft. high low wall: 4 feet on center.
 - 9. Spacing for 5 ft. high low wall: 4 ft. on center.
 - 10. Spacing for 6 ft. high low wall: 4 ft. on center.

11. Base plate is secured to concrete floor slab with 1/2-inch diameter steel bolt fasteners with 3-1/2 inch minimum embedment.
 12. Manufacturer and Product:
 - a. NoFlex, Inc; NoFlex - The Low Wall Support Solution (Basis-of-Design)
NoFlex, Inc.
9121 Atlanta Avenue, Suite 333
Huntington Beach, California 92646
Ph: (800) 720-1994
Website: www.noflex.com
 - b. Approved equal.
- K. Extruded Aluminum Partition Closure: Provide in specified lengths and size to fit specified openings.
1. Material: Extruded aluminum, 6063-T5
 2. Finish: Factory-anodized in clear or medium bronze.
 3. Accessories: WindowMate End Caps, extruded.
 - a. MMEC-487 for 4-7/8-inch-thick partitions.
 - b. MMEC-600 for 6-inch-thick partitions.
 - c. MMEC-725 for 7-1/4-inch-thick partitions.
 4. Provide WindowMate 3 (SERIES 30) for openings 2 7/8" – 3 15/16".
 5. Provide WindowMate 4 (SERIES 30) for openings 4" – 4 15/16".
 6. Provide WindowMate 5 (SERIES 30) for openings 5" – 5 15/16".
 7. Provide acoustic insulation (as specified) within concealed mullion chassis.
 8. Manufacturer and Product:
 - a. Gordon, Inc.; MullionMate 30 (Basis-of-Design)
Gordon Interior Specialties Division.
5023 Hazel Jones Road
Bossier City, LA 71111
Ph: (800) 747-8954
Website: www.gordoninteriors.com
 - b. Approved equal.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
 - 1. 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 indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 - 1. Space studs as follows:
 - a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
 - b. Multilayer Application: 16 inches o.c., unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating 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 runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- D. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
 4. Install custom furring over support framing as shown in the details in the contract documents.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8-inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

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SECTION 090120 – PATCHING LARGE HOLES IN PLASTER WITH PLASTER

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. The procedures include general guidelines offered by GSA (US Government Services Administration) to follow when restoring plaster in historic buildings. It identifies specific design issues and outlines recommended installation solutions that have the least visual or physical impact on the historic materials. This procedure includes guidance on repair of large plaster holes greater than 4-inches in diameter. When larger sections of plaster are missing, drywall patches may be used as a base.
- B. Related Requirements:
 - 1. Division 09: Patching Small Holes in Cracks & Plaster.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Sustainable Submittals:
- C. Product Data: for adhesives, documentation including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports:
 - 1. Expansion anchors.
 - 2. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from weather in waterproof enclosure. Provide for air circulation around materials.

1.6 QUALITY ASSURANCE

- A. These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the State Historic Preservation Officer (SHPO).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drywall and joint compound.
- B. Nails and screws.
- C. Joint tape (cloth mesh preferred).

2.2 EQUIPMENT

- A. 6-inch taping knife.
- B. 12-inch taping knife.
- C. Float.
- D. Hawk.
- E. Sanding sponge (medium fine grit).
- F. Stiff putty knife.
- G. Goggles, work gloves, and dust mask.
- H. Hammer and cold chisel.
- I. Needle nose pliers and wire cutter.
- J. Screw gun and drill.
- K. Spray bottle and drop cloths.
- L. Tin snips.
- M. Vacuum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Determine the extent of damaged plaster. Look for:
 - 1. Holes.
 - 2. Water Stains: Brownish rings on the plaster, especially the ceilings, indicate that the plaster has been wet. If the water was stopped quickly, the surface may only need to be sealed with pigmented shellac to prevent the stain from bleeding through the new paint or wallpaper. However, if the leak continued for a long period, the plaster will need to be replaced, and will often have a powdery appearance.
 - 3. Chipping, flaking and delamination of plaster due to water infiltration.

3.2 EXECUTION / INSTALLATION / APPLICATION

- A. Removing Deteriorated Plaster:
 - 1. Remove loose plaster from the walls by hand (or flat pry bar may also be helpful in removing plaster that is difficult to remove by hand).
 - 2. To remove sound plaster, for whatever reason, drill holes in the line of cut with a carbide drill bit; Holding the chisel at a shallow angle, carefully cut directly from hole to hole with a cold chisel; Cut the resulting plaster free from the lath by chipping the keys from the side.
 - 3. Cut the plaster back to the nearest studs to make a regular opening, and re-secure the lath with drywall nails.
 - 4. Use plaster washers and wood screws to re-secure weakly-keyed areas of sound plaster to the wall or ceiling.
 - 5. Knock any plaster stuck between the lath back into the wall cavity.
 - 6. Vacuum all dust, loose plaster, and other debris from the hole with a shop-vac, or sweep it out with an old paintbrush.
- B. Making a Sheetrock Patch
 - 1. Shim the Sheetrock as required to bring it up flush with the surface of the adjacent plaster.
 - 2. Cut a Sheetrock patch to fit neatly in the opening.
 - 3. Nail or screw the sheetrock in place; nail heads or screw heads should be set slightly below the surface of the Sheetrock, but without breaking the paper.

4. Using the 6-inch taping knife, fill the joint between the Sheetrock and the plaster with a small amount of joint compound.
5. Apply a fairly smooth, heavy coat of compound over the joint a little wider than the tape width.
6. Center the joint tape over the length of the joint; Hold the 6-inch taping knife at a 45-degree angle and press the tape into the compound; Smooth out any air pockets under the tape.
7. Apply a thin layer of compound over the tape and apply a first coat of compound to nails or screws.
8. Knock off any ridges or pimples that develop from shrinkage and cracking in the compound.
9. Apply the second coat of compound with the 6-inch taping knife and feather the edges out 6-8 inches; Scrape off any ridges or bumps.
10. When the second coat is dry, apply the third coat of compound with the 12 inch taping knife and feather the edges out 12-14 inches.
11. Touch up low spots with additional compound or high spots by light sanding with a wet sanding sponge.

3.3 WASTE MANAGEMENT

A. Coordinate with Division 01.

1. Separate and recycle cut-offs and waste materials and material packaging in accordance with Waste Management Plan and to the maximum extent economically feasible and place in designated areas for recycling.
2. Set aside and protect materials suitable for reuse and/or remanufacturing.
3. Separate and fold up metal banding; flatten and place along with other metal scrap for recycling in designated area.

END OF SECTION 090120

SECTION 092320 – PATCHING SMALL HOLES & CRACKS IN PLASTER

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. The procedures include general guidelines offered by GSA (US Government Services Administration) to follow when restoring plaster in historic buildings. It identifies specific design issues and outlines recommended installation solutions that have the least visual or physical impact on the historic materials. This procedure includes guidance on repair of patching small chips, cracks, or depressions in plaster surfaces.
- B. Related Requirements:
 - 1. Division 09: Patching Large Holes & Cracks in Plaster.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Sustainable Submittals:
- C. Product Data: for adhesives, documentation including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports:
 - 1. Expansion anchors.
 - 2. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from weather in waterproof enclosure. Provide for air circulation around materials.

1.6 QUALITY ASSURANCE

- A. These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the local preservation office or State Historic Preservation Officer (SHPO).

1.7 REFERENCES

- A. American National Standards Institute (ANSI) Standard Specifications: ANSI, 1430 Broadway, New York, NY 10018.
- B. American Society for Testing and Materials (ASTM) Standard Specifications: ASTM, 1916 Race Street, Philadelphia, PA 19103-1187, 215/299-5400.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. U.S. Gypsum Association 810 First Street NE, #510 Washington, DC 20002 202/289-5440, FAX 202/289-3707

2.2 MATERIALS

- A. Gypsum Plaster Materials:
 - 1. General: gypsum plastering materials shall conform to ANSI A42.1. Provide neat or ready-mixed materials at installer's option unless indicated otherwise.
 - 2. Base coat plaster: Perlite gypsum plaster such as "Structo-Lite" (U.S. Gypsum Association), or approved equal.
 - 3. Base coat aggregate: Sand.
 - 4. Finish coat plaster: Keene's cement.
 - 5. Finishing lime: Installer's option for type.
- B. Bonding Materials: Bonding agent shall conform to ASTM C631.

2.3 EQUIPMENT

- A. Joint knife.
- B. Sponge or heavy-nap cloth.
- C. Crack widener or triangular can opener.

- D. Stiff bristle brushes.
- E. Hawk.
- F. Slicker (flexible straight-edge).
- G. Plasterer's trowel.
- H. Margin trowel.
- I. Mortarboard and mud pan.
- J. Pointing trowel.

PART 3 - EXECUTION

3.1 EXECUTION, INSTALLATION, APPLICATION

- A. Scrape loose or damaged finish plaster and peeling paint from surface with chisel or joint knife. Remove material where required to enlarge cracks, chips, holes, etc. to at least 1/2 inch across and undercut to improve bonding of new material.
- B. Brush or vacuum surface to remove dust and debris.
- C. Moisten the surface by lightly spraying a fine mist of clean water from a spray bottle.
- D. Apply skim finish coat over low areas to bring entire finished surface out flush with the projecting firm and sound layers of adjacent plaster or paint. Form plaster as required to match original configuration and design or ornamental plaster.
- E. Once dry, sand by hand to produce a surface without bumps, cracks, or depressions, ready to receive finish treatment.

3.2 ADJUSTING/CLEANING

- A. Upon completion of this work, all floors, walls, and other adjacent surfaces that are stained, marred, or otherwise damaged by work in this procedure shall be cleaned and repaired and all work and the adjacent areas shall be left in a clean and perfect condition.
- B. All completed work shall be adequately protected from damage by subsequent building operations and effects of weather. Protection shall be by methods recommended by the manufacturer of installed materials and as approved by Architect.

3.3 WASTE MANAGEMENT

A. Coordinate with Division 01.

1. Separate and recycle cut-offs and waste materials and material packaging in accordance with Waste Management Plan and to the maximum extent economically feasible and place in designated areas for recycling.
2. Set aside and protect materials suitable for reuse and/or remanufacturing.
3. Separate and fold up metal banding; flatten and place along with other metal scrap for recycling in designated area.

END OF SECTION 092320

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
- C. Samples for Initial Selection: For each type of trim accessory indicated.
- D. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12 inch (300 mm) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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 C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M, Mold and Moisture Resistant.

1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 2. Thickness: 5/8 inch (15.9 mm), unless noted otherwise.
 3. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M, Mold and Moisture Resistant.
1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company ; Gold Bond Brand XP Fire Shield Gypsum Board.
 2. Thickness: 5/8 inch (15.9 mm), unless noted otherwise.
 3. Long Edges: Tapered.
- C. Gypsum Ceiling Board, Type C: ASTM C 1396/C 1396M.
1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company; High Strength Brand Ceiling Board.
 2. Thickness: 1/2 inch (12.7 mm).
 3. Long Edges: Tapered.
- D. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M, Mold and Moisture Resistant.
1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company; Hi-Abuse Brand XP Gypsum Board.
 2. Core: 5/8 inch (15.9 mm), Type X, unless noted otherwise.
 3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company ; eXP Tile Backer.
 2. Core: 5/8 inch (15.9 mm), Type X.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 4. Locations of use: Toilet Rooms.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 2. Shapes:
 - a. Cornerbead.

- b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet Corporation; Reveal Molding and Expansion Joints.
 - a. Expansion and Control Reveal Joints: Fry Reglet DB.1 Drywall Expansion Joint, tow piece, 1/2 inch x 1/2 inch: DRM-50-50-2-PC.
 - b. Control Joints at joints to walls and soffits is Fry Reglet DA.9 "W Reveal", 1/2 inch by 1/2 inch : DRWT-50-50.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
 - 4. Approved aluminum trim equal: R. H. Tamlyn & Sons, Ltd. www.tamlyn.com; Tel: (800) 334-1676

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
- 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10 by 10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
- 1. Basis of Design: ProForm XP with Dust Tech.
 - 2. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 3. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - 4. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 5. Finish Coat: For third coat, use drying-type, all-purpose compound.

6. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

2.8 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Acoustical Finish: Refer to Section 098316 Spray Acoustic Plaster. See dwgs for types and locations. Areas (Ceiling Clouds) getting acoustic finish to receive level 3 finish as base for acoustic finish.

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, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 to 3/8 inch (6.4 to 9.5 mm) wide joints to install sealant.

- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4 to 1/2 inch (6.4 to 12.7 mm) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- B. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers

- at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- D. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated] locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: As base for acoustic finish.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 5. Level 5: Where vinyl wall signage is proposed, refer to Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.7 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

3.8 PROTECTION

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

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 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. Glazed wall tile.
 - 2. Stone thresholds.
 - 3. Waterproof membrane.
 - 4. Metal edge strips.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Module Size: Actual tile size plus joint width indicated.
- C. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch (150-mm) lengths.
4. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Product Test Reports: For tile-setting and -grouting products.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with unbroken seals 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 could be maintained and contamination could 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from a single manufacturer.
 - 2. Obtain waterproof membrane, except for sheet products, from manufacturer of setting and grouting materials.

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 unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards

referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

- C. Factory 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.

2.3 TILE PRODUCTS

A. Ceramic Tile **Type CWT-1 and CWT-2**: Glazed wall tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dal Tile, Color Wheel Linear; Glossy. Refer to Schedule for locations.
2. Module Size: 6" x 18".
3. Tile Color: Refer to Material Legend on drawing AF001.
4. Grout Color: As selected by Architect from manufacturer's full range.
5. Mortar for Toilet and Shower Rooms: Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3 and ISO R2.
 1. Product: Subject to compliance with requirements, provide MAPEI Corporation "Kerapoxy 410".
 2. Provide all components for showers including waterproofing.
6. Mortar for Corridor Walls: Non-flammable organic adhesive, complying with ANSI A136.1 and ISO 13007 D2TE; MAPEI, "Type 1" adhesive or MAPEI, "Ultramastic ECO," or Ker 909, ISO 13007; D1TE.
7. Grout: Factory Blended, Polymer-Modified Tile Grout for grout joints from 1/16-inch to 3/4-inch (1.5 mm to 19 mm) and meeting ANSI A118.7 and ISO 13007; CGWAF.
 - a. Product: Subject to compliance with requirements, provide MAPEI Corporation "Ultracolor Plus FA".

B. Ceramic Tile Base **Type CTB-1**: Glazed wall base.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dal Tile, Color Wheel Linear; Glossy. Refer to Schedule for locations.
2. Module Size: 4" x 12".
3. Tile Color: Refer to Material Legend on drawing AF001.
4. Grout Color: As selected by Architect from manufacturer's full range.
5. Mortar for Toilet and Shower Rooms: Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3 and ISO R2.
 3. Product: Subject to compliance with requirements, provide MAPEI Corporation "Kerapoxy 410".
 4. Provide all components for showers including waterproofing.

6. Mortar for Corridor Walls: Non-flammable organic adhesive, complying with ANSI A136.1 and ISO 13007 D2TE; MAPEI, "Type 1" adhesive or MAPEI, "Ultramastic ECO," or Ker 909, ISO 13007; D1TE.
7. Grout: Factory Blended, Polymer-Modified Tile Grout for grout joints from 1/16-inch to 3/4-inch (1.5 mm to 19 mm) and meeting ANSI A118.7 and ISO 13007; CGWAF.
 - a. Product: Subject to compliance with requirements, provide MAPEI Corporation "Ultracolor Plus FA".

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16-inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2-inch (12.7 mm) or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 12 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and A118.12, and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 1. Product: Subject to compliance with requirements, provide MAPEI Corporation, Mapelastastic 400.
 2. Product: Subject to compliance with requirements, provide MAPEI Corporation, Mapelastastic HPG.

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

- B. Grout Release: product formulated to protect exposed surfaces of unglazed or unpolished floor tile against adherence of mortar and grout; compatible with tile, mortar and grout products.
- C. Edge Strips/Metal Transitions, Vertical Locations:
 - 1. Basis of Design:
 - a. CWT to CWT: Schluter; Quadec, Anodized Aluminum. Full height, one piece.
 - b. CWT to PNT or X-Door Frames: Schluter; Schiene, Anodized Aluminum. Full height, one piece.
- D. Edge Strips/Metal Transitions, floor, and base locations:
 - 1. Basis of Design manufacturer: Schluter.
 - 2. Schedule:
 - a. Existing Terrazzo →CFT: Schluter Reno-T.
 - b. New Terrazzo→CFT: Schluter Reno – TK.
 - c. CFT→CPT: Schluter Reno – TK.
 - d. CFT→RT: Schluter Reno – TK.
 - e. CFT→VCT: Schluter Reno – TK.
 - f. WOM→CFT: Schluter Schiene.
 - g. CWT →RB: Schluter Schiene.
 - h. CWT →CPT: Schluter; Schiene.
- E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. indicated.
 - 3. Verify that concrete substrates for tile floors installed with adhesives 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.
 - 4. 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.
 - 5. 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. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile walls in wet areas.
 - b. Tile walls consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - c. Tile walls consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. 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.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16-inch (1.6 mm).
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
 2. Do not extend waterproofing under thresholds. Fill joints between such thresholds and adjoining tile set on waterproofing with elastomeric sealant.
- J. Metal Edge Strips: Install at locations indicated.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than ten (10) days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 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.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes: Acoustical panels and suspension systems for ceilings, suspended cloud systems.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6 inch (150 mm) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6 inch (150 mm) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling 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. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
5. Perimeter moldings.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical Gypsum Board Ceiling and Cloud, minimum 10 sq. ft area.
2. 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 acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned

space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than forty-eight (48) hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.
- B. Fire-Resistance Ratings: Comply with ASTM E 119; 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 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.

- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc. Refer to Schedule for locations.
- B. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type IV, mineral fiber, Form 2.
 - 2. Pattern: E (lightly-textured).
- C. Panel Criteria:
 - 1. Color: White.
 - 2. LR: Not less than 0.90.
 - 3. NRC: Not less than 0.75.
 - 4. CAC: Not less than 35.
 - 5. Edge/Joint Detail: Square.
 - 6. Thickness: 3/4-inch.
 - 7. Modular Size: 24 by 24 inches, and 24 by 48 inches.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no

mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

- E. Suspension System: Prelude XL 15/16-inch Exposed Tee.

2.4 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc. Refer to Schedule for locations.
- B. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type XII, fiberglass, Form 2.
 - 2. Pattern: E.
- C. Panel Criteria:
 - 1. Color: White.
 - 2. LR: Not less than 0.90.
 - 3. NRC: Not less than 0.90.
 - 4. Edge/Joint Detail: 1/4-inch reveal with 15/16-inch Vector.
 - 5. Thickness: 7/8-inch.
 - 6. Modular Size: 48 by 48 inches.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- E. Suspension System: Prelude XL 15/16-inch.

2.5 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc. Refer to Schedule for locations.
- B. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type IV, mineral fiber, Form 2.
 - 2. Pattern: E (lightly-textured).
- C. Panel Criteria:

1. Color: White.
 2. LR: Not less than 0.90.
 3. NRC: Not less than 0.75.
 4. CAC: Not less than 35.
 5. Edge/Joint Detail: Square.
 6. Thickness: 3/4-inch.
 7. Modular Size: 24 by 24 inches.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
- E. Suspension System: Prelude XL 15/16-inch Exposed Tee.
- F. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flamespread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.

2.6 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm) diameter wire.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- F. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
 2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

3. For Cloud Ceilings (Where ceiling does not touch wall.) provide Armstrong 'Axiom' trim, 2 inches high. Color to be selected by Architect.

2.8 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Company; SHEETROCK Acoustical Sealant.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Exposed and Concealed Joints: Non-sag, paintable, non-staining latex sealant.
 2. Concealed Joints: Non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.
 - 2. Retain applicable subparagraphs below that coordinate with panel edge details and suspension-system types specified in a schedule.
 - 3. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 4. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 5. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 - 6. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 7. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
 - 8. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 - 9. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Rubber molding accessories.

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, not less than 12 inches (300 mm) long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- E. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 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. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 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 (10 deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite Rubber Base.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:
 - a. Baseworks Cove.
 - b. Baseworks Toeless.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: As indicated on Drawings.
- E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors: Refer to Material Schedule on drawing AF001.

2.2 RUBBER MOLDING ACCESSORY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite.
- B. Description: Rubber nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet, transition strips.
- C. Profile and Dimensions: As indicated
- D. Schedule:
 1. Existing Terrazzo →CPT /Johnsonite CTA-XXX-J.
 2. Existing Terrazzo →VCT / Johnsonite RRS-XXX-D.
 3. New Terrazzo → VCT / Johnsonite RRS-XXX-D.
 4. CPT →VCT / Johnsonite SLT-XXX-A.
- E. Colors and Patterns: Refer to Material Schedule on drawing AF001. Match Architect's sample.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread 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 resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. 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 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from resilient flooring before applying liquid floor polish.
 - 1. Apply two coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber floor tile.
 - 2. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
- D. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one (1) box for every forty (40) boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - a. Size: Minimum 50 sq. ft. (4.6 sq. m) for each type, color, and pattern in locations directed by Architect.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.

3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Armstrong World Industries, Inc. Tile Standard: ASTM F 1066, Class 2, through pattern.
- B. Wearing Surface: Smooth.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Name: Excelon Imperial Texture; Excelon Multicolor.
- E. Size, Colors and Patterns: Match existing, and refer to drawing AF001.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

1. Provide under all flooring going over existing concrete slabs and existing terrazzo slabs, typical.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

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

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- a. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Resilient flooring over Terrazzo: Strip floor wax in preparation of carpet installation. Remove shine of terrazzo through mechanical means to allow for adhesive adhesion.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis unless otherwise indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other non-permanent marking device.

- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile 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 floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish for VCT: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply three (3) coats.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes one resinous flooring system, one with epoxy body.
 - 1. Application Method: Flat metal or plastic blade, power or hand troweled.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 5 inches (150 mm) square, applied to a rigid backing.
- C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Maintenance Data: For resinous flooring, include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. No request for substitution shall be considered that would change the generic type of floor system specified (i.e. Epoxy resin mortar-based flooring system with urethane sealers). Equivalent materials of other manufactures may be substituted only on approval of Architect or Engineer. Request for substitution will only be considered only if submitted ten (10) days prior to bid date. Request will be subject to specification requirements described in this section.
- B. 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. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
 2. Contractor shall have completed at least 10 projects of similar size and complexity.
- C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- D. 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.
- E. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Pre-installation Conference:
1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
 2. Attendance:
 - a. Prime Contractor
 - b. Architect / Construction Manager.
 - c. Manufacturer / Installer's Representative.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with unbroken seals, 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. Store material per product data.
- 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.

1.6 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

1.7 WARRANTY

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

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include:
 - 1. Broadcast systems will not be accepted. Trowel mortar only.
- B. Acceptable Manufacturers:
 - 1. Basis of Design: Stonhard.
- C. Product: Subject to compliance with requirements:
 - 1. Stonhard, Inc.; Stonblend GSI®.
- D. System Characteristics:
 - 1. Color and Pattern: TBD.
 - 2. Wearing Surface: Smooth, Matte finish.
 - 3. Overall System Thickness: 3/16-inch (5 mm).
- E. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - 1. Primer:
 - a. Material Basis: Stonblend Primer.
 - b. Resin: Epoxy.
 - c. Formulation Description: 2-part, 100% solids.
 - d. Type: Non-pigmented.
 - e. Finish: Standard.
 - f. Number of Coats: One (1).
 - 2. Mortar Base:
 - a. Material Basis: Stonblend Mortar.
 - b. Resin: Epoxy.
 - c. Formulation Description: 3-part, 100% solids.
 - d. Application Method: Flat Metal or plastic blade trowel.
 - 1) Thickness of Coats: 3/16-inch (5 mm).
 - 2) Number of Coats: One (1).
 - e. Aggregates: Pigmented quartz Blended aggregate.
 - 3. Groutcoat:
 - a. Material Basis: Stonblend Groutcoat.
 - b. Resin: Epoxy.
 - c. Formulation Description: 2-part, 100% high solids.
 - d. Type: Clear.
 - e. Finish: Standard.

- f. Number of Coats: One (1).
 - 4. Sealer:
 - a. Material Basis: Stonkote CE4.
 - b. Resin: Epoxy
 - c. Formulation Description: 2-part, 100% solids.
 - d. Type: Clear.
 - e. Finish: Matte.
 - f. Number of Coats: One (1).
 - 5. Topcoat:
 - a. Material Basis: Stonseal CF7.
 - b. Resin: VOC EPA Compliant, Waterborne, Aliphatic Polyurethane.
 - c. Formulation Description: 2-part 100% high solids.
 - d. Type: Clear.
 - e. Finish: Matte.
 - f. Number of Coats: Two (2).
- F. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - 1. Compressive Strength: 6,000 psi after 7 days per ASTM C 579.
 - 2. Tensile Strength: 1,500 psi per ASTM C 307.
 - 3. Flexural Strength: 2,200 psi per ASTM C 580.
 - 4. Flexural Modulus of Elasticity: 5.0×10^5 psi per ASTM C 580.
 - 5. Hardness: 85 to 90, Shore D per ASTM D 2240.
 - 6. Impact Resistance: >160 in. lbs. per ASTM D 2794.
 - 7. Abrasion Resistance: 0.06 gm max. weight loss per ASEM D 4060, CS-17.
 - 8. Flammability: Class 1 per ASTM E-648, E-662.
 - 9. Thermal Coefficient of Linear Expansion: 9×10^{-6} in./in °F.
 - 10. VOC Content per ASTM D 2369, Method E.
 - a. Stonblend Primer: 75 g/l
 - b. Stonblend GSI Base: 17 g/l
 - c. Stonblend Groutcoat: 52 g/l
 - d. Stonkote CE4: 34 g/l
 - e. Stonseal CF7: 47 g/l (Method C)
 - 11. Cure Rate: 12 hours for foot traffic, 24 hours normal operations.

2.2 ACCESSORY MATERIALS

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated. Formulation Description: Stonhard Stonblend Primer, 100% solids.
- B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated. Formulation Description Only if application above grade Stonproof ME7.

- C. Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- D. 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean and dry substrate for resinous flooring applications.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Mechanically prepare substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup or Diamond Grind with a dust-free system.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 - 3. Verify that concrete substrates 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. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- D. Treat control joints and other non-moving 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. Troweled Mortar: Mix mortar material according to manufacturer's recommended procedures. Uniformly spread mortar over substrate using manufacturer's specially designed screed box adjusted to manufacturer's recommended height. Hand trowel apply mixed material over freshly primed substrate using steel finishing trowels or power trowel material using manufacturer's specially designed power trowel blades.
- D. Groutcoat: Remove excess unbonded granules by lightly abrading or scraping and vacuuming the floor surface. Mix and apply grout coat with strict adherence to manufacturer's installation procedures and coverage rates.
- E. Sealer: Lightly sand or scrape surface to remove any floor surface irregularities. Mix and apply sealer with strict adherence to manufacturer's installation procedures.
- F. Matte Finish: Lightly sand or scrape surface to remove any floor surface irregularities. Mix and roller apply mar resistant finish with strict adherence to manufacturer's installation procedures.

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

3.5 FIELD QUALITY CONTROL

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

3.6 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.
- 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.

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SECTION 099100 – PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item, or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed structural columns and related elements; exposed and bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefabricated items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefabricated items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Visual display surfaces.
 - c. Toilet enclosures.
 - d. Metal lockers.
 - e. Aluminum window and doorframes.
 - f. Coiling overhead doors.
 - g. Impact resistant wall protection.
 - h. Operable panel partitions.
 - i. Storage shelving.
 - j. Finished mechanical and electrical equipment.
 - k. HVAC inlets and outlets.
 - l. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts.
3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

1. Division 05 Section "Structural Steel" for shop priming structural steel.
2. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.
3. Division 05 Section "Pipe and Tube Railings" for shop priming railings.
4. Division 06 Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
5. Division 08 Section "Hollow Metal Doors and Frames" for factory priming steel doors and frames.
6. Division 08 Section "Flush Wood Doors" for factory finishes to flush wood doors.

1.3 DEFINITIONS AND REFERENCES

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi-gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

- B. PDCA (Painting and Decorating Contractors of America) – Painting - Architectural Manual.
- C. SSPC (Steel Structures Painting Council) – Steel Structures Painting Manual.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 - 3. Submit two (2) samples on the following substrates for Architect's review of color and texture only:
 - a. Ferrous Metal: 4-inch square samples of flat metal and 8-inch-long samples of solid metal for each color and finish.
 - b. Gypsum board and plaster: 12-inch square samples for each color and finish.
- C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings 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.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and each new and existing substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 square feet.
 - b. Small Areas and Items: Architect will designate items or areas required.
2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 - b. Refinish benchmark areas according to finish schedule prior to completion of Work following Architects direction and approval.
3. Final approval of finishes and colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F and a maximum of 90 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

- C. 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 the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and, in the quantities, described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
 - 1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
 - a. Two (2) full unopened gallons of each color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Benjamin Moore & Co. (Benjamin Moore).
 - 2. Sherwin-Williams
 - 3. PPG Industries, Inc.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: Colors, textures, and other physical characteristics of the final finish may be referenced by specification of a single manufacturer's numbering system. Match referenced materials.

2.3 CONCRETE UNIT MASONRY BLOCK FILLERS

- A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
 1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.
 2. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.

2.4 EXTERIOR PRIMERS

- A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
 1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. Z06: Applied at a dry film thickness of not less than 2.0 mils.
 2. Sherwin-Williams; Kem Bond HS Universal Metal Primer B50 Series: Applied at a dry film thickness of 2.0-2.5 mils.
- B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
 1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 2. Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66-310 Series: Apply at a dry film thickness of 2.0-4.0 mils.

2.5 INTERIOR PRIMERS

- A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.

1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 2. Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils.
- B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 2. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
- C. Interior Plaster Primer: Factory-formulated latex-based primer for interior application.
1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 2. Sherwin-Williams; PrepRite Masonry Primer B28W300 Series: Applied at a dry film thickness of not less than 3 mils.
- D. Interior Wood Primer for Acrylic-Enamel and Semigloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
1. Benjamin Moore; Fresh Start Alkyd Enamel Underbody and Primer Sealer No. 217: Applied at a dry film thickness of not less than 1.5 mils.
 2. Sherwin-Williams; PrepRite Classic Interior Primer B28W101 Series: Applied at a dry film thickness of not less than 1.6 mils.
- E. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
1. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. Z06: Applied at a dry film thickness of not less than 2.0 mils.
 2. Sherwin-Williams; Kem Bond HS Universal Metal Primer B50 Series: Applied at a dry film thickness of 3.0-8.0 mils.
- F. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 2. Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66-310 Series: Applied at a dry film thickness of 5.0-10.0 mils.
- G. Interior Semigloss Epoxy Primer/Sealer: Factory-formulated semigloss epoxy primer/sealer for interior application

1. Sherwin-Williams; ArmorSeal 33 Epoxy Primer/Sealer: Applied at a dry film thickness of not less than 8.0 mils.

2.6 EXTERIOR FINISH COATS

- A. Exterior Semi-gloss Acrylic Enamel: Factory-formulated semi-gloss waterborne acrylic-latex enamel for exterior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex House & Trim Paint No. 170: Applied at a dry film thickness of not less than 1.1 mils.
 2. Sherwin-Williams; A-100 Latex Gloss A8 Series: Applied at a dry film thickness of not less than 1.3 mils.
- B. Exterior Low-Luster Acrylic Paint: Factory-formulated low-sheen (eggshell) acrylic-latex paint for exterior application.
 1. Benjamin Moore; Moorcraft Super Spec Low Lustre Latex House Paint No. N185: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).
 2. Sherwin-Williams; A-100 Exterior Latex Satin House & Trim Paint A82 Series: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).

2.7 INTERIOR FINISH COATS

- A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex Flat No. 275: Applied at a dry film thickness of not less than 1.2 mils.
 2. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series: Applied at a dry film thickness of not less than 1.4 mils.
- B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
 1. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. C274: Applied at a dry film thickness of not less than 1.3 mils.
 2. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
- C. Interior Semi-gloss Acrylic Enamel: Factory-formulated Semi-gloss acrylic-latex enamel for interior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.
 2. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface- applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Plaster Surfaces: Fill hairline cracks, small holes, and other imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

3. Gypsum Board Surfaces: Fill minor defects with filler compound. Make smooth and flush with adjacent surfaces. Spot prime defects after repair.
4. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a five percent (5%) solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry and vacuum before painting.
5. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
6. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

7. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.

- B. Scheduling Painting: 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.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 - 1. Uninsulated metal piping.
 - 2. Uninsulated plastic piping.
 - 3. Uninsulated ductwork.
 - 4. Pipe hangers and supports.
 - 5. Tanks that do not have factory-applied final finishes.

6. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 7. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 8. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
1. Exposed conduits and junction boxes.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- 3.4 FIELD QUALITY CONTROL
- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing, or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 1. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior semi-gloss acrylic enamel.
- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:

1. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior semi-gloss acrylic enamel.
- C. Exterior Gypsum Soffit Board: Provide the following finish system over exterior gypsum soffit board:
 1. Low-Luster Acrylic Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior gypsum soffit board primer.
 - b. Finish Coats: Exterior low-luster acrylic paint.

3.8 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:
 1. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior concrete and masonry primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- B. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:
 1. Low-Luster Acrylic-Enamel Finish: Two (2) finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 2. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- C. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 1. Flat Acrylic Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior flat acrylic paint.
 2. Low-Luster Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 3. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- D. Plaster: Provide the following finish systems over new interior plaster surfaces:

1. Low-Luster Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior plaster primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 2. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior plaster primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- E. Wood and Hardboard: Provide the following paint finish systems over new interior wood surfaces:
1. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a wood undercoater.
 - a. Primer: Interior wood primer for acrylic-enamel and semi-gloss alkyd-enamel finishes.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- F. Ferrous Metal: Provide the following finish systems over ferrous metal:
1. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- G. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
1. Semi-gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.

END OF SECTION 099100

SECTION 099735 – FIELD-APPLIED DRY ERASE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Systems for field-applied dry erase coatings.

1.3 REFERENCES

- A. ASTM D 16: Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
- B. Painting & Decorating Contractors of America (PDCA) Standards: P1 to P24.
- C. Gypsum Association (GA): GA 214, Recommended Levels of Gypsum Board Finish.

1.4 DEFINITIONS

- A. Definitions of Painting Terms: ASTM D 16, unless otherwise specified.
- B. DFT: Dry film thickness.

1.5 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product information for each coating, including generic description, complete technical data, storage and handling requirements and application instructions.
- B. Color Samples: Prepare color and finishes samples, 8-1/2 inches x 11 inches in size. Samples shall be resubmitted as requested until required sheen, color, and texture is achieved. Label and identify each sample as to location and application.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Quality Assurance: Submit manufacturer's certification that

coatings comply with specified requirements and are suitable for intended application.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions: Provide manufacturer's recommended maintenance and cleaning instructions for the coated surfaces.
- B. Warranty: Three (3) signed copies.

1.8 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer of high performance coatings with a demonstrated minimum of ten (10) years of successful experience.
 - 2. Manufacturer shall supply a list of successfully completed projects of a comparable type.
 - 3. Source Responsibility: Coatings shall be products of a single supplier.
- B. Applicator's Qualifications:
 - 1. Experienced in application of specified coatings for a minimum of five (5) years on projects of similar size and complexity to this Work.
 - 2. Applicator's Personnel: Supervisory personnel shall be trained/experienced in the successful application of the specified coatings.
- C. Comply with applicable codes and regulations of government agencies having jurisdiction over airborne emissions, rinse runoff and industrial waste disposal. Where those requirements conflict with this specification, comply with the more stringent provisions.
- D. Comply with current applicable regulations of the state and local air pollution control agencies/districts and the Environmental Protection Agency (EPA).
- E. Mock-ups:
 - 1. Before proceeding with the work, apply a sample area of approximately 100 square feet, including primer, to an area as directed by the Architect.
 - 2. Prepare mock-ups for Architect's review and to establish requirements for substrate finish and final coating application, texture, sheen, and color.
 - 3. Correct areas, modify method of application and installation, or adjust finish texture as directed by the Architect to comply with the specified requirements.
 - 4. Maintain mock-up accessible to serve as a standard of quality for this

Section.

5. Accepted mock-up may remain in place.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to job site in manufacturer's original, unopened containers and packaging, with all labeling clearly identifying:
 1. Coating or material name.
 2. Manufacturer.
 3. Color name and number.
 4. Batch or lot number.
 5. Date of manufacture.
 6. Mixing and thinning instructions.
- B. Storage:
 1. Store materials in a clean, dry area and within temperature range in accordance with manufacturer's instructions.
 2. Keep containers sealed until ready for use.
 3. Do not use materials beyond manufacturer's shelf life limitations.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.10 PROJECT CONDITIONS

- A. Weather:
 1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
 3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
- B. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.
- C. Dust and Contaminants:
 1. Schedule coating work to avoid excessive dust and airborne contaminants.
 2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Water penetration through the coating.
 - b. Deterioration of coating beyond normal weathering.
 - 2. Warranty Period: Ten (10) years from date of Substantial Completion.
- B. The manufacturer's warranty is to be fully paid for by the coating applicator. The Warranty shall cover both labor and materials, without financial limits, required to remove defective materials and recoat areas in which moisture has penetrated structurally sound materials.
- C. Provide warranty signed by the Contractor, coating applicator and manufacturer.
- D. This warranty is in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. MDC. FUZE Dry Erase Coating.
 - 2. Sherwin-Williams. Dry Erase Clear Gloss Coating.
 - 3. Or other as approved by Architect.
- B. Dry erase coating performance requirements:
 - 1. Colors: Clear.
 - 2. VOC (EPA Method 24)
 - a. Clear 89 g/L Part A&B mixed.
 - 3. Solids:
 - a. Clear 92 percent.
 - 4. Gloss: ASTM D 523.
 - a. Clear 90+ at 60 degrees.
 - 5. Fire Rating: ASTM E 84, Class A.

C. Recommended acrylic primers:

1. Sherwin-Williams Multi-Purpose Latex Primer/Sealer
2. Glidden Gripper Primer.
3. Kilz Premium Primer.

2.2 INTERIOR COATING SYSTEMS

A. Gypsum Board:

1. System Type: Acrylic primer / modified epoxy dry erase topcoat.
2. Surface Preparation: Remove hardware, accessories, plates, and similar items to allow dry erase coatings to be installed.
3. Primer.
4. Finish Coat: MDC FUZE.
5. Sheen: Gloss.
6. Total DFT: 4.0 to 8.0 mils.

2.3 ACCESSORIES

- A. Use accessories required for application of specified coatings in accordance with manufacturer's recommendations, including thinners.
1. Roller: Purdy White Dove 1/4-inch nap roller as included in kit by manufacturer. No substitutions permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which dry erase coating system is to be applied. Notify Architect of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.
- B. Wall surfaces to receive dry erase coating shall be dry and free from dirt, grease, loose paint, and scale.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage

during surface preparation and application of coatings.

- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.3 SURFACE PREPARATION

A. Gypsum Board:

1. Prepare gypsum board surfaces in accordance with Level 5 Drywall Finish.
2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
3. Sand joint compound smooth and feather the edge to match.
4. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.
5. Do not apply putty, patching pencils, caulking, or masking tape to gypsum board surfaces to be painted.
6. Lightly scuff sand tape joints after priming to remove raised paper nap. Do not sand through primer

B. Medium-Density Fiberboard (MDF):

1. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
2. Scuff sand the substrate with 150 to 220 grit sandpaper to achieve a slight etch.

C. Previously-Coated Surfaces:

1. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
2. Scuff sand the substrate with 150 to 220 grit sandpaper to achieve a slight etch.
3. Before applying dry erase coating, a test or mock-up shall be performed to ensure adhesion, appearance and color are compatible with the existing substrate coating.

3.4 APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.

- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.5 REPAIR

- A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. Coating Defects: Repair, in accordance with manufacturer's instructions, coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.6 CLEANING

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.7 PROTECTION OF COATING SYSTEMS

- A. Protect surfaces of coating systems from damage during construction.

END OF SECTION 099735

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SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.
 - a. White Boards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
- C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
 - 1. Samples of facings for each visual display panel type, indicating color and texture.
 - 2. Actual factory-finish color samples, applied to aluminum substrate.
 - 3. Include accessory Samples to verify color selected.
- D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of whiteboards.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings. Include accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 2. Warranty Period: Minimum fifty (50) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 VISUAL DISPLAY BOARD ASSEMBLY

- 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. Claridge Products and Equipment, Inc.
- B. Visual Display Board Assembly: factory-fabricated.
 1. Assembly: Markerboard and tackboard.

2. Corners: Square.
 3. Width: As indicated on Drawings.
 4. Height: As indicated on Drawings.
 5. Mounting Method: Direct-to-wall.
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on 7/16-inch MDF core.
1. Color: White.
- D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; slim size and standard shape.
1. Aluminum Finish: Clear anodic finish.
- E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- F. Combination Assemblies: Provide hidden spline between abutting sections of visual display panels.
- G. Chalk tray: Manufacturer's standard; continuous.
- H. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, designed to hold accessories.
1. Size: 1 inch (25 mm) high by width of display.
 2. Map Hooks: Two (2) map hooks for every 48 inches (1200 mm) of display rail or fraction thereof.
 3. Aluminum Color: Match finish of visual display assembly trim.

2.4 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics to comply with a Class A finish.
- C. Hardboard: ANSI A135.4, tempered.
- D. Medium Density Fiberboard: ASTM C 208 cellulosic fiber insulating board.

- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- F. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

2.5 GENERAL FINISH REQUIREMENTS

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

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
- C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.
- D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Room Identification signs.
 - 2. Miscellaneous signage.
 - 3. Field-applied, vinyl-character signs.

1.3 DEFINITIONS

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

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.

- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Panel Signs: Full-size Sample.
 - 2. Field-Applied, Vinyl-Character Signs: 12-inch x 12-inch sample.
- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

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

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 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.
 - d. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Mohawk Sign Systems.
 - 2. Gemini Incorporated.
 - 3. Or approved equal.
- B. Panel Sign: Sign with smooth, uniform surfaces; with message and characters and Braille having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Room Sign: Melamine plastic resin sheet.
 - a. Overall Sheet Thickness: 0.125 inch (3.18 mm).
 - b. Color: Provided by Architect..
 - 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
 - 3. Mounting: Surface mounted to wall with countersunk flathead through fasteners. Adhesive applied on Glass with matching back panel.
 - 4. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.
 - 5. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16-inch (1.5 mm) measured diagonally from corner to corner.

2.3 FIELD-APPLIED, VINYL-CHARACTER SIGNS

- A. Field-Applied, Vinyl-Character Sign: Pre-spaced characters die cut from 3- to 3.5-mil (0.076- to 0.089-mm) thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Graphics, Inc.
 - b. Inpro Corporation.
 - c. Mohawk Sign Systems.
 - 2. Size: 12-inch high, final size, copy and design to be selected and approved by Architect.
 - 3. Substrate: Painted partitions.
 - 4. Text and Font: Font to be selected by Architect.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 - 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant head slots unless otherwise indicated.
 - 3. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.
- B. Melamine plastic shall be CNC router cut for precise dimensions according to specifications.
- C. Characters and pictograms shall be routed out and sandblasted to raise them 1/32" in a one-piece construction to meet ADA compliance regulations. Engraved tactile letters are not suitable.
- D. Raised text shall be in all capital letters and accompanied by corresponding Grade 2 Braille.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
- D. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply

and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fish-mouths. Remove carrier film without disturbing applied vinyl film.

- E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 101423

SECTION 102641 – BALLISTICS RESISTANT PANELS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes bullet-resistant fiberglass panels.

1.2 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM E119-98 Standard Test for One-Hour Fire-Rating of Building Construction and Materials.
 - 2. ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials/Assemblies, Class IV.
- B. International Organization for Standardization:
 - 1. ISO 9001:2015 Quality Management System.
- C. National Institute of Justice Ballistic Standards:
 - 1. NIJ Standard 0108.01 – Type III-A.
- D. Small Business Administration:
 - 1. SBA Small Business Size Standard.
- E. Underwriters Laboratories:
 - 1. UL 752 Specifications and Ammunition, 11th Edition, Standard for Bullet Resisting Equipment published September 9, 2005, revised December 21, 2006, Level 4.
- F. The United States Department of State:
 - 1. The International Traffic in Arms Regulations (ITAR).

1.3 SUBMITTALS

- A. Submittals for Review: Submit for approval prior to fabrication.
 - 1. Product Data: Include specifications, brochures, and samples.
 - 2. Recommendations for installation of Bullet Resistant Fiberglass Panels available in print document and video link.

B. Certificates: Submit printed data to indicate compliance with following requirements.

1. UL LISTING Verification and UL752 Current Test Results as provided by Underwriters Laboratories.
2. ASTM E119-98 One-Hour Fire Rating of Building Construction and Materials.
3. ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials / Assemblies.
4. Manufacturer's third party certificate of registration with ISO 9001:2015.
5. Manufacturer's U.S. Dept. of State ITAR Statement of Registration.
6. Manufacturer's SBA Profile verifying small business status by the SBA.

1.4 DELIVERY, HANDLING, AND STORAGE

- A. Deliver materials to project with manufacturer's UL LISTED Labels intact and legible.
- B. Handle material with care to prevent damage. Store materials inside under cover, stack flat and off the floor.

1.5 WARRANTY

- A. Warrant all materials and workmanship against defects for a period of ten (10) years from the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design: ArmorCore by Waco Composites, Waco, TX 76710, phone: 254-752-3622, toll free: 866-688-3088, email: sales@armorcore.com, web: www.armorcore.com.

2.2 PERFORMANCE CRITERIA

- A. Ballistics Resistant Fiberglass Panels shall be "non ricochet type" to permit the capture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.
- B. Panel Rating: UL752 Level 3.
- C. Bullet resistance of joints: Equal to that of the panel.

2.3 MATERIALS

- A. Panels fabricated of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets.
- B. Thickness: 7/16-inch (1.11 cm) nominal thickness.
- C. Nominal Weight: 4.8 lbs. per sq. ft.
- D. Available Panel Sizes: 4'-0" x 8'-0".
- E. Panels manufactured in the United States of America with raw materials sourced from the U.S.A. for quality assurance purposes and to comply with any applicable "Buy American" provisions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting installation, verify work of related trades required in contract documents and architectural drawings is complete to the point where work of this Section may properly commence.

3.2 JOINTS

- A. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4-inches, centered on panel joints.

3.3 APPLICATION

- A. Install armor in accordance with manufacturer's printed recommendations and as required by contract documents.
- B. Secure armor panels using screws, bolts, or an industrial adhesive.
 - 1. Method of application shall install panels minimizing vulnerabilities by fitting tightly to adjacent surfaces including concrete floor slab, concrete roof slab, bullet resistive door frames, bullet resistive window frames, and the like.

END OF SECTION 102641

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SECTION 102800 – TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bathroom accessories.
 - 2. Custodial accessories.
- B. Owner-Furnished, Contractor-Installed Material: Paper towel dispensers, soap dispensers, sanitary napkin waste receptacle, and toilet paper dispenser.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Manufacturer's warranty.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.6 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.

1.7 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Fifteen (15) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- C. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- D. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 TOILET ROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Or equal.
- B. Grab Bar:
 - 1. Mounting: Flanges with concealed fasteners.
 - 2. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 3. Outside Diameter: 1-1/4 inches.
 - 4. Configuration and Length: As indicated on Drawings.
- C. Mirror Unit:

1. Basis-of-Design Product: Bobrick; B-165 Series.
2. Frame: Stainless-steel channel.
 - a. Corners: Manufacturer's standard.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
4. Size: As indicated on Drawings.

2.3 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Bobrick Washroom Equipment, Inc.
 2. Or Equal.
- B. Mop and Broom Holder:
 1. Basis-of-Design Product: Bobrick, B-239x34.
 2. Description: Unit with shelf, hooks, holders, beneath shelf.
 3. Length: 34 inches.
 4. Mounting Height: field-directed.
 5. Hooks: Four.
 6. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
 7. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
 8. Locations: Provide one unit per renovated or new Custodial Closet.
- C. Stainless Steel Shelf:
 1. Basis-of-Design Product: Bobrick; B-298x24.
 2. Description: Shelf with hemmed edges.
 3. Length: 24 inches.
 4. Material and Finish: 18 gauge type 304 Stainless steel, No. 4 finish (satin). 16 gauge Stainless Steel brackets.
 5. Location: Provide one (1) unit per renovated or new Custodial Closet.

2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
 - b. Firemans key box.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets and firemans key box. Include plans, elevations, sections, details, and attachments to other work.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis-of-Design: Subject to compliance with requirements, provide Larsen's Manufacturing Company, Architectural Series.
 - 2. Babcock-Davis
 - 3. JL Industries, Inc., a division of the Activar Construction Products.
 - 4. Or approved equal.
- B. Cabinet Construction: Non-rated and 1-hour fire-rated. Provide rated cabinet when in a rated wall assembly.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09 mm) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16 mm) thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Surface-Mounted Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2½-inch (64 mm) backbend depth.
- E. Cabinet Trim Material: Steel sheet.
- F. Door Material: Steel sheet.
- G. Door Style: Center glass panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide manufacturer's standard.
 - 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Silk-screened or Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.

K. Materials:

1. Stainless Steel: ASTM A 666, Type 304.
 - a. Finish: No. 4 directional satin finish.
2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FIREMANS KEY BOX

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Knox Company; Knox-Box 3200 Series, Hinged door Model.
 1. Surface Mount box size: 4 inches wide x 5 inches high.
 2. Box depth: 3 inches.
 3. Color: To be selected by Architect.
- B. Fabrication: Bolt to building envelop support system.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2-inch (13 mm) thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where surface-mounted cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates for surface-mounted fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide surface-mounted fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six (6) years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket 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. Ansul Incorporated; Tyco International Ltd.
 - b. Badger Fire Protection; a Kidde company.
 - c. Buckeye Fire Equipment Company.
 - d. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - e. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - f. Larsen's Manufacturing Company.
 - g. Potter Roemer LLC.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel 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. Ansul Incorporated; Tyco International Ltd.
 - b. Badger Fire Protection; a Kidde company.
 - c. Buckeye Fire Equipment Company.
 - d. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - e. Larsen's Manufacturing Company.
 - f. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- C. Locations: Refer to Drawings.

END OF SECTION 104416

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SECTION 122413 - ROLLER WINDOW SHADES

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. Manually-operated roller shades with single rollers – all new window openings and those existing-to-remain contained within renovated spaces.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than [10 inches (250 mm)] [3 inches (76 mm)] square. Mark inside face of material if applicable.
 - 2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for each type of roller shade indicated.
- E. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Certificates: For each type of shadeband material, signed by product manufacturer.
- C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.7 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.

1.8 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper Inc; Manual Flex Shade or a comparable product by one of the following:
 - 1. Hunter Douglas Contract.
 - 2. MechoShade Systems, Inc.

- B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY-OPERATED SHADES WITH SINGLE ROLLERS

- A. 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.
 - 1. Bead Chains: Nickel-plated metal.
 - a. Loop Length: Length required to make operation convenient from floor level. Indicate length in submittal schedule.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
- B. 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.
 - 1. Roller Drive-End Location: Right side of inside face of shade.
 - 2. Direction of Shadeband Roll: Regular, from back of roller.
 - 3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- E. Shadebands:
 - 1. Shadeband Material: Light-blocking fabric.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: Same as shadeband.
- F. Installation Accessories:
 - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

- a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than four (4) inches (102 mm).
2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
 1. Source: Basis of Design Fabric – Roc-rol by Roc-Ion (Rockland).
 2. Type: Polyester-cotton blend.
 3. Weight: 13.0 – 13.5 oz./sq. yd. (g/sq. m).
 4. Roll Width: As indicated on drawings.
 5. Orientation on Shadeband: Up the bolt.
 6. Features: Emergency Rescue Notice.
 - a. Provide notice on window shade of same size, text, and font whenever window shade covers notice on window identified as a rescue window.
 7. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4-inch (6 mm) per side or 1/2-inch (13 mm) total, plus or minus 1/8-inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4-inch (6 mm), plus or minus 1/8-inch (3.1 mm).

2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
 1. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 1. Opaque Shadebands: Located so shadeband is not closer than two (2) inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches (150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. DuPont Corian or approved equal.
 - 2. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops: **1/2-inch- (12.7-mm-)** thick, solid surface material with front edge built up with same material.
- D. Backsplashes: **1/2-inch- (12.7-mm-)** thick, solid surface material.
- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints: Fabricate countertops without joints.
- G. Cutouts and Holes:
 - 1. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of **1/8 inch in 8 feet (3 mm in 2.4 m)**, **1/4-inch (6 mm)** maximum. Do not exceed **1/64-inch (0.4-mm)** difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- D. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- E. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 124813 – ENTRANCE FLOOR MATS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Entrance floor mats and frames, including fibered roll good entrance systems.
- B. Related requirements:
 - 1. Drawings and General Provisions of the Contract including General and Supplementary Conditions and Division 01 References Section
 - 2. Section 033000 Cast-In-Place Concrete: Subfloor preparation.

1.2 REFERENCE STANDARDS

- A. ASTM International.
 - 1. D 2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
 - 2. E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
- B. European Norms (EN).
 - 1. EN 1815 Resilient and textile floor coverings. Assessment of static electrical propensity
- C. International Standards Organization (ISO).
 - 1. ISO 105 B02 Colour fastness to artificial light: Xenon arc fading lamp test.
 - 2. ISO 105 E01 Colour fastness to water.
 - 3. ISO 105 x12 Colour fastness to rubbing.
- D. Other referenced documents
 - 1. Consumer Products Safety Commission (CPSC) FF 1-70: Pill Test.
 - 2. Department of Commerce (DOC) FF 1-70: Pill Test.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Install entrance matting after finishing operations, including painting and ceiling operations, have been completed.

- B. Preinstallation Meetings: Meet to confirm project requirements, substrate conditions, manufacturer's installation instructions and warranty requirements in compliance with Division 01 requirements.

1.4 ACTION SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures.
- B. Product Data: For specified products, submit latest edition of product supplier's technical specifications data.
- C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components.
- D. Samples: Submit selection and verification samples showing the required finishes, colors, designs, and textures for flooring, as well as samples of adhesives and applicable accessories such as nosing, frames, etc.

1.5 INFORMATION SUBMITTALS

- A. Test and Evaluation Reports
 - 1. Product test reports: As required by Conditions of the Contract and Division 01 Regulatory Requirements Section, submit test certificates from an independent test laboratory showing compliance with specified performance characteristics and physical properties.
 - 2. Compatibility and adhesion test reports: Submit test reports confirming adhesive's effectiveness with the product(s) specified.
- B. Manufacturer Instructions: For specified products, submit latest editions of product supplier's installation and cleaning & maintenance instructions.

1.6 CLOSEOUT SUBMITTALS

- A. Warranty documentation: For specified products and accessories, submit product supplier's warranty documents.

1.7 QUALITY ASSURANCE

- A. Installer: Installer shall be highly experienced in performing work of this section, having previous done fiber roll goods installation work similar to that required for this project.

- B. Testing Agency: Agency shall be independent and qualified to perform the specified product tests.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 01 Product Requirements Section.
- B. Delivery and Acceptance Requirements: Comply with the product supplier's ordering and lead time requirements to avoid construction delays, and to allow material to acclimatize as required in the specified product's installation instructions. Accept delivery of materials only if they are in unopened, undamaged packaging that bears the name and brand of the manufacturer/product supplier, project identification, and shipping and handling instructions.
- C. Storage and Handling Requirements: Store material -- including any adhesive and accessories -- in the original packaging (as delivered) in areas that are enclosed and weather tight with the permanent HVAC system set at a temperature of between 65°F and 80°F for a minimum of 48 hours prior to commencement of installation. In addition, comply with storage and handling requirements listed on product packaging, and described in the latest edition of the product's installation instructions.

1.9 AMBIENT SITE CONDITIONS

- A. The permanent HVAC system shall be operational and set at a temperature of between 65°F and 80°F for a minimum of 48 hours prior to commencement of installation, during the time of installation, and for 48 hours after installation has been completed. Thereafter, minimum temperature shall be 55°F.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Supplier: Mats Inc., 179 Campanelli Parkway, Stoughton, MA 02072; telephone: 1.800.MATS.INC (1.800.628.7462); fax: 1.781.344.1537; email: info@matsinc.com; website: www.matsinc.com.
- B. Substitutions: Refer to Section 013300 for permitted methods.
- C. Product: Berber
Construction: 100% solution-dyed polypropylene fiber with rubber backing.
Size: Refer to Drawings.
Thickness: 5/8-inch.

Weight: 64 ounces/square yard.
Colors: Charcoal.

- D. Performance: Physical properties of the entrance matting shall conform to the following minimums:

Berber:	
Safety	
Surface flammability	ASTM D2859 Pass (equal to CPSC FF 1-70 and DOC FF 1-70)
Smoke density	ASTM E662 Pass
Performance	
Static electrical propensity	EN 1815: < 2 kV
Color fastness to light	ISO 105 B02: ≥ 6
Color fastness to water	ISO 105 E01: 5
Color fastness to rubbing	ISO 105 X12: dry:3 - 4; wet: 4
Color fastness to shampoo	BS 1006: 4 - 5

2.2 ACCESSORY PRODUCTS

- A. Adhesive: Architect to specify adhesive and trowel notch size per the latest edition of the installation instructions.
- B. Other:
1. Standard sew-on nosing
 2. Aluminum framing: specify as recommended by Mats Inc.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Overall: Follow guidelines laid out in Division 01, Section 017100 – Examination and Preparation as well as Section 014300 – Quality Assurance.
- B. Verification of Conditions: Subfloors shall be clean and dry. Inspect all substrates and subfloors for proper tolerances, and report any discrepancies to the general contractor in writing.
- C. Preinstallation Measurements: Verify actual measurement by field measuring before any onsite cutting, if applicable. To avoid construction delays, coordinate field measurements based upon construction progress.

- D. Evaluation and Assessment: See the state requirements for the project location.

3.2 SURFACE PREPARATION

- A. Follow guidelines laid out in Section 017100 – Examination and Preparation.
- B. Concrete subfloors: Where concrete subfloors are present, all work required to put the concrete subfloor in acceptable condition shall be the responsibility of the general contractor. See the state requirements for the project location.

3.3 INSTALLATION

- A. Follow Division 01 relevant guidelines, and the latest edition of the manufacturer's installation instructions.
- B. Interface with Other Work: If transitions are required to and/or from the specified entrance matting, contact Mats Inc. for suitable transition material.
- C. Sizes: Where not indicated otherwise, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning. Where possible, verify sizes by field measurement before shop fabrication.
- D. Accessory selection: Where indicated for recessed or wall-to-wall applications provide aluminum framework as recommended by manufacturer. Where indicated for surface-mounted applications, provide tapered vinyl moldings with flanges sewn to back of mat on all four sides with mitered corners.

3.4 CLEANING

- A. General: Clean up job site, including sweeping or dust mopping the floor to remove all dirt or grit, and put all waste in general contractor's dumpster. Follow overall cleaning guidelines described in Division 01.
- B. Initial Maintenance: Conduct a full initial maintenance following the latest edition of the manufacturer's maintenance instructions. Instruct owner's cleaning staff in proper maintenance procedures.

END OF SECTION 124813

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SECTION 220000 - SCOPE OF WORK

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.
- B. All work under this title, on drawings or specified, is subject to the architectural general and special contract conditions for the entire project, and the contractor for this portion of the work is required to refer especially thereto, and to the architectural drawings.

1.2 SCOPE OF WORK

- A. This contractor shall refer to Division 1 for additional scope items required by Contract including but not limited to the listed as "Summary of Work Multiple Prime Contracts" for Scope of Work Summary by Contract.
- B. The following is a general listing of work items to be provided under this Contract. Work indicated is not necessarily all inclusive, nor shall it limit the extent of the work or exclude any work shown or specified and not listed.
- C. Contractor shall furnish all materials, equipment and labor to make the following complete installations:
 - 1. Temporary water as required for work and that is necessary to maintain continuous service to building use and occupants.
 - 2. Schedule "shutdowns" in advance with the Owner.
 - 3. Cutting and patching as required to accomplish the work indicated including painting finish work.
 - 4. Complete hot water, hot water return, tempered water, and cold water distribution systems as indicated on plans for all new plumbing fixtures and equipment.
 - 5. Furnishing and installing of plumbing fixtures, equipment and specialties.
 - 6. Insulation and Identification of piping and valves as required by the specifications but not limited to pipe identification and valve identification for all systems.
 - 7. Sleeves and plates including fire stop material.
 - 8. Testing, start-up and balancing of all plumbing installations to include

domestic hot water, domestic cold water, and domestic hot water return systems. Balancing work shall include rebalancing of all existing and new domestic hot water systems.

9. Servicing of plumbing equipment installed as required during guarantee period for a minimum of one year after Owner's acceptance.
10. Provide competent factory-trained personnel at site for the purpose of instructing Owner's personnel in proper operation and maintenance of all new plumbing equipment.
11. Preparation and submission of coordination drawings to include coordination with all trades involved in the renovated and new work areas.
12. All work as shown and indicated on plumbing drawings and as specified in Division 22. Plumbing demolition work shall include but not be limited to the complete removal of material and equipment from the site.

END OF SECTION 220000

SECTION 220015 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division1 Specification Sections, apply to this Section.

1.2. SCOPE OF WORK

- A. Provide cutting and patching work required by work of this (sub) contract.
- B. Do not cut and patch in a manner that would result in a failure of the work to perform as intended, decreased structural integrity, decreased integrity of fire proofing, decreased energy performance, increased maintenance, decreased operational life or decreased safety. Specific attention shall be paid to the 2020 NYS Building Code, including Chapter 23 with regard to boring and notching of wood structural members.
- C. Requirements in this Section apply to mechanical, plumbing and electrical installations. Refer to Divisions 23 and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations. Requirements of this section shall be coordinated with requirements of Division 1 sections. In the event of conflict, the more stringent requirements shall be used.

1.3. DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4. QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. This is to include but not be limited to the following:
1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire Protection systems.
 4. Control systems.
 5. Communication systems.
 6. Conveying systems.
 7. Electrical wiring systems.
 8. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise and vibration control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed work listed below. If it is impossible to engage original installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched veneer woodwork.
 - e. Preformed metal panels.
 - f. Roofing.
 - g. Firestopping.
 - h. Window wall system.

- i. Stucco and ornamental plaster.
 - j. Terrazzo.
 - k. Finished wood flooring.
 - l. Fluid-applied flooring.
 - m. Aggregate wall coating.
 - n. Wall covering.
 - o. HVAC enclosures, cabinets, or covers.
- E. Cutting and Patching Conference: Before proceeding, meet at project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5. WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED PENETRATIONS

- A. Refer to Specifications Sections 3 through 20.

2.2 FIRESTOP MATERIAL

- A. Through-Penetration Firestop Devices, Forming Materials, and Fill, Void or Cavity Materials: As listed in the UL Fire Resistance Directory, Warnock Hersey Certifications Listings Book or the Omega Point Laboratories Listing Directory.
- B. General: Comply with requirements specified in other Sections of these Specifications.
- C. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
 - 2. Fit work airtight to pipes, sleeves, ducts, conduits and other penetration through surfaces.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 5. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other sections of these specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

3.4 FIRESTOP THROUGH-PENETRATIONS

- A. Firestop through-penetrations to prevent the passage of flame, smoke, fumes and hot gasses, and maintain the fire resistive rating of walls, partitions, ceilings, and floors. Use an appropriate through-penetration firestop system as found in the UL Fire Resistance Directory. Products shall be installed per the manufacturer's instructions and in accordance with their UL listings.
 - 1. Insulated pipes - select a system where the pipe insulation is permitted to pass through the construction. Insulation shall conform to the requirements of the firestop system UL listing.
 - 2. Insulated ducts - insulation shall not extend through construction required to have a fire resistive rating of 2 hours or greater.
 - 3. Pipes, tubing, conduits, cables and other building services - provide an appropriate UL listed firestop system.

END OF SECTION 220015

SECTION 220413

PENETRATION FIRESTOPPING PLUMBING

PART 1 GENERAL

1.1 REFERENCES

- A. UL 1479 Fire Tests of Through-Penetration Firestops.
- B. ASTM E 814 Standard Method of Fire Tests of Penetration Firestops Systems.

1.2 DEFINITIONS

- A. UL Fire Resistance Directory: Product directory published yearly, with supplements, by Underwriters Laboratories Inc., containing listings and classifications in effect as of the published date for product categories covered by UL.
- B. Inchcape Directory of Listed Products: Product directory published yearly by Inchcape Testing Services containing listings which reflect certifications granted for materials, products, systems and equipment which have been tested by Inchcape Testing Services to recognized governing standards.
- C. Omega Point Laboratories Listings Directory: Product Directory published yearly by Omega Point Laboratories, Inc. containing listed building products, materials, and assemblies which have been tested by Omega Point Laboratories to recognized governing standards.
- D. Factory Mutual Approval Guide: Product directory published yearly, with supplements, by Factory Mutual Research Corp., containing listed building products, materials, and assemblies which have been tested by Factory Mutual Research Corp., to recognized governing standards.
- E. F Rating: Prohibits flame passage through the system and requires acceptable hose stream test performance.
- F. Company Field Advisor: An employee of the Company which lists and markets the primary components of the system under their name who is certified in writing by the Company to be technically qualified in design,

installation, and servicing of the required products or an employee of an organization certified by the foregoing Company to be technically qualified in design, installation and servicing of the required products. Personnel involved solely in sales do not qualify.

1.3 DESIGN REQUIREMENTS

- A. Devices and materials shall meet the hourly fire resistance ratings required by the Project as determined by UL 1479, or ASTM E 814 and be listed and detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. Exception: Where no listed designs exist that meet the requirements of a specific project condition, submit details and manufacturer's written recommendations for a design meeting the requirements. Include evidence of engineering judgement and extrapolation from listed designs.

1.4 SUBMITTALS

- A. Submittals Package: Submit the following items specified below the same time as a package:
 - 1. Product Data.
 - 2. Samples.
 - 3. Quality Control Submittals.
 - 4. Firestop Schedule.
- B. Product Data: Catalog sheets, specifications and installation instructions for each firestop device and material.
 - 1. Indicate design number for each firestop proposed to be used which is detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 2. State the specific locations where each firestop system is proposed to be installed.
- C. Samples: One of each product if requested.
- D. Quality Control Submittals:
 - 1. Design Data: Show details and include engineering information and manufacturer's written recommendations required under Design Requirements Article for each proposed firestop if other

than a design detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.

- a. State the specific locations where each firestop is proposed to be installed.
2. Installer's Qualifications Data:
 - a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
 - b. Names and addresses of 3 similar projects that each person has worked on during the past 5 years.
3. Company Field Advisor Data:
 - a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor, and listing of services and each product specifically listed for this Project for which Company Field Advisor is given authorization by the Company to render advice.
- E. Firestop Schedule: Submit schedule itemizing the following:
 1. Manufacturer's product reference numbers and/or drawing numbers.
 2. UL, Inchcape Testing Services, Factory Mutual Research Corp., or Omega Point Lab design number.
 3. Location of firestop material.
 4. Penetrating Item Description/Limits: Material, size, insulated or uninsulated, and combustibility.
 5. Maximum allowable annular space or maximum size opening.
 6. Wall type construction.
 7. Roof type construction.
 8. Hourly Fire resistance rating of wall.
 9. F rating.

NOTE: Firestop Schedule is for information only, and will not be acted on for approval. Refer to Sample Firestop Schedule bound in Appendix.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: The persons installing the firestopping and their supervisor shall be personally experienced in firestop work and shall have

been regularly employed by a company installing firestopping for a minimum of 3 years.

- B. Pre-Installation Conference: Before the firestop work is scheduled to commence, a conference will be called by the Director's Representative at the Site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by related trade Contractors (if any), their qualified firestopping installers, and associated firestopping manufacturer's Company Field Advisors.
- C. Container/Package Labels: Include manufacturer's name and identifying product number, date of manufacturer, lot number, shelf life (if applicable), qualified testing and inspecting agency classification marking, curing time, and mixing instructions for multi-component materials.
- D. Company Field Advisor: Secure the services of a Company Field Advisor for the following:
 - 1. Render advice regarding suitability of firestopping materials and methods.
 - 2. Assist in completing firestop schedule.
 - 3. Attend pre-installation conference.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping materials to the Site in original, new unopened containers or packages bearing manufacturer's printed labels.
- B. Store and handle firestopping materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, etc.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Temperature: Do not install firestopping materials when ambient or substrate temperatures are outside limits permitted by manufacturer of firestopping materials.
 - 2. Humidity and Moisture: Do not install the Work of this Section under conditions that are detrimental to the application, curing, and performance of the materials.
 - 3. Ventilation: Provide sufficient ventilation wherever firestopping materials are installed in enclosed spaces. Follow manufacturer's recommendations.

1.8 SEQUENCING AND SCHEDULING

- A. Leave exposed those firestopping installations that are to be concealed behind other construction until the Director's Representative has examined each installation.

PART 2 PRODUCTS

2.1 FIRESTOPPING-GENERAL

- A. Through-Penetration Firestop Devices, Forming Materials, And Fill, Void or Cavity Materials: As listed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. For firestopping exposed to moisture, furnish products that do not deteriorate when exposed to this condition.
 - 2. For firestopping systems exposed to view, furnish products with flame-spread values of less than 25 and smoke developed values less than 50, as determined per ASTM E 84.
 - 3. For penetrations for piping services below ambient temperature, furnish moisture-resistant through-penetration firestop systems.
- B. Accessories: Components required to install fill materials as recommended by the firestopping manufacturer for particular approved fire rated system.
- C. Identification Labels:
 - 1. Furnished by fire stopping manufacturer of suitable material for permanent field identification of through-penetration firestops.
 - 2. Identify the following:
 - a. "WARNING - FIRESTOP MATERIAL".
 - b. Company Name.
 - c. Product Catalog number.
 - d. F rating.
 - 3. Field fabricated labels are not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing through-penetrations of walls, partitions, ceilings and roofs in the Work areas.
- B. Where firestopping is missing or not intact, submit a written report to the Director's Representative describing the existing conditions.

3.2 PREPARATION

- A. Clean out openings immediately before installation of through-penetration firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove foreign materials from surfaces of openings, and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Protection:
 - 1. Protect surfaces adjacent to through-penetration firestops with non-staining removable masking tape or other suitable covering to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or that would be caused by cleaning methods used to remove smears from firestopping materials.
- C. Substrate Priming:
 - 1. Prime substrates in accordance with the firestopping manufacturer's printed installation instructions using recommended products and methods.
 - 2. Do not allow primer to spill or migrate onto adjoining exposed surfaces.

3.3 INSTALLATION OF THROUGH PENETRATION FIRESTOPS

- A. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, and limit temperature rise of the unexposed surface as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form through-penetration firestop in accordance with approved printed details and installation instructions from the company producing the forming materials and fill, void or cavity material.
 - 2. If the construction type(s) of the building cannot be determined, provide firestopping with fire resistance ratings as specified in the International Building Code, Tables 721.1(1), 721.1(2), 721.1(3), and 508.4.
- B. Provide through-penetration firestop systems with F ratings which shall equal or exceed the fire resistance rating of the penetrated building construction.
- C. Firestop through-penetrations of walls, partitions, ceilings, and roofs.
- E. Permanently affix label at each firestop. Use adhesive compatible with surface construction at firestop location.

3.4 CLEANING

- A. Clean off excess fill materials and sealants adjacent to penetrations by methods and cleaning materials recommended by manufacturers of firestopping products and of products in which penetrations occur.
- B. Remove masking tape as soon as practical so as not to disturb the firestopping's bond with substrate.
- C. Protect firestopping during and after curing period from contact with contaminating substances, or damage resulting from adjacent Work.
- D. Cut out and remove damaged or deteriorated firestopping immediately, and install new materials as specified in firestop schedule.

END OF SECTION 220413

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

- A. This Section includes the following basic materials and methods to complement other Division 22 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Labeling and identifying plumbing systems and equipment is specified in Division 22 Section "Piping Identification".
 - 5. Non-shrink grout for equipment installations.
 - 6. Field-fabricated metal and wood equipment supports.
 - 7. Installation requirements common to equipment specification sections.
 - 8. Plumbing demolition.
 - 9. Cutting and patching.
 - 10. Touch-up painting and finishing.
- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3. DEFINITIONS

- A. Pipe, pipe fittings, and piping includes; tube, tube fittings, connection devices, and tubing for various applications, and of a specific material applicable for intended use.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels. Normally occupied use spaces.

- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, storage rooms, and mechanical equipment rooms.
- D. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings, chase areas, and in duct shafts.

1.4. SCOPE OF WORK

- A. The following is a general listing of work items to be provided under this Contract. Work indicated is not necessarily all inclusive, nor shall it limit the extent of the work or exclude any work shown or specified and not listed.
- B. This Contractor shall refer to Division 1 for additional scope items required by Contract including but not limited to the listed as "Summary of Work Multiple Prime Contracts" for Scope of Work Summary by Contract"
- C. All plumbing demolition work as indicated on the P drawings, and as specified including but not limited to the complete removal of material and equipment from the site.
- D. Contractor shall furnish all materials, equipment and labor to make the following complete installations:
 - 1. All work as outlined previously in Section 220000.
 - 2. All work as shown and indicated on P drawings and as specified in Division 22.

1.5. DIMENSIONAL INFORMATION

- A. Dimensional information used for layout and locations shall be taken from architectural or structural drawings used by the construction trades.
- B. Plumbing drawings are diagrammatic and have no dimensional significance. Do not scale. Locations of equipment and piping are to be as:
 - 1. Shown on Architectural drawings;
 - 2. Directed in the field;
 - 3. Required for proper connection of equipment to be served;
 - 4. Required for proper symmetry in the space involved;
 - 5. With deviations made only with specific approval of Architect.

- C. Division 22 shall review the drawings of other divisions, exchange shop drawings with them, cooperate in the preparation or prepare space layouts as required, to avoid conflicts and interferences with the installation of other trades in advanced stages of construction.
- D. Contractor shall field verify all existing conditions prior to installation of equipment and material. It is recommended that the contractor verify all existing conditions prior to submitting a proposal. Lack of field verification does not constitute a basis for additional monies during construction. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.

1.6. PERMITS, CODES AND ORDINANCES

- A. The Plumbing Contractor shall arrange and pay for all permits, inspections, etc., as required by local utilities or applicable agencies.
- B. All work and material shall be in complete accordance with the ordinances, regulations, codes, etc., of all political entities exercising jurisdictions, specifically including the NYS Energy Code.

1.7. CONFLICTS

- A. If, in the interpretation of contract documents, it appears that the drawings and specifications are not in agreement, the Contractor is to contact the Engineer. The Engineer shall be the final authority. Addenda supersede the provisions which they amend.
- B. In the absence of a written clarification by the engineer, the Contractor must install his work in accordance with the more stringent and/or costly condition. Contractor assumes full responsibility for any and all items furnished and installed without the written approval by the Architect or Engineer. Under no circumstances will a change order be accepted for work installed that was not approved by the Architect or Engineer.

1.8. SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Required Shop Drawings

SECTION	MATERIAL ITEM
220413	PENETRATION FIRESTOPPING PLUMBING
220523	VALVES
220529	HANGERS AND SUPPORTS
220553	PLUMBING IDENTIFICATION
220719	PIPE INSULATION
221113	WATER DISTRIBUTION PIPING
221310	DRAINAGE & VENT SYSTEMS
224200	PLUMBING FIXTURES

- C. Product data for the following piping specialties:
 - 1. Identification materials and devices.
- D. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- E. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for plumbing materials and equipment.
- F. Coordination drawings for access panels and door locations.
- G. Prepare coordination drawings according to Division 1 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the work. Include the following:
 - 1. Proposed locations of piping, equipment, and materials. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve stem movement.
 - b. Planned duct systems layout, obtain layout from HVAC (Sub) Contractor.
 - c. Clearances for installing and maintaining insulation.
 - d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.

- e. Equipment service connections and support details.
 - f. Fire-rated wall and floor penetrations.
 - g. Sizes and locations of required concrete pads and bases.
 - 2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings, and their relationship to other penetrations and installations.
- H. Welder certificates signed by (Sub) Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article of this Section.
- I. If substitutions are proposed after the bids are received, the Contractor shall state the amount of credit to the Owner for substitution. Substitutions that are considered equal by the contractor and carried in bid without approval by the Engineer shall be the responsibility of the Contractor. The Engineer and/or Owner shall not be made liable or responsible for losses incurred by the Contractor, due to the rejection of said items for installation.

1.9. QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code - Steel".
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping".
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.10. COORDINATION WITH OTHER TRADES

- A. Check Division 22 drawings with all others.
- B. Anticipate and avoid interferences with all other trades.
- C. Take particular care to coordinate all piping, ductwork, plumbing and major electrical components above ceiling, to prevent conflict. Remove and relocate work as may be made necessary by such conflict, at no extra cost to the owner. Provide coordination drawings as described in the Submittals paragraph of this section. (Refer to Division 1 for additional requirements). Lack of coordination drawings assumes the contractor has verified and coordinated all work associated with installation.
- D. Obtain decision for approval from project engineer for proposed group installation before proceeding, and for clearance in structure and finish of the building.
- E. Running pipe over electrical equipment and elevator machine rooms is prohibited.
- F. The Contractor to coordinate with, receive and install, Owner furnished equipment where indicated.

1.11. DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect fittings, and piping specialties from moisture and dirt.

1.12. MISCELLANEOUS SUPPORT

- A. Mechanical Contractor is responsible for providing all miscellaneous support components necessary for properly supporting equipment provided by Mechanical Contractor including hangers, rods, anchors, steel, etc.

1.13. SEQUENCING AND SCHEDULING

- A. Coordinate plumbing equipment installation with other building components.
- B. Arrange and coordinate for chases, slots, and opening in building structure during progress of construction, to allow for plumbing installations. Coordinate with other trades.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed. Do not alter structural members, and do not over stress.
- D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building. Comply with all applicable inspections required by Authority Having Jurisdiction.
- E. Coordinate connection of electrical services and circuits needed.
- F. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors".
- H. Coordinate installation of identifying devices after completion of covering and painting where devices are applied to surfaces. Install identifying devices prior to installations of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification sections in Division 22 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1-8-inch maximum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
 - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
- C. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
 - 2. Alloy Sn50: Tin (50 percent) and lead (50 percent). Drainage, Waste & Vent (DWV) copper only.
 - 3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10 percent maximum lead content.
 - 4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10 percent maximum lead content.
 - 5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10 percent maximum lead content.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126. Class B, gray iron.
 - 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type, where required to conceal protruding fittings and sleeves.
 - 1. Inside Diameter: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. Outside Diameter: Completely cover opening.
 - 3. Cast Brass: One-piece, with set-screw.
 - a. Finish: Polished chrome plate.
 - 4. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
 - 5. Cast-Iron Floor Plate: One-piece casting.
- B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 - 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 - 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - 3. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 deg F. temperature.
 - 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system pressures.
 - 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
 - 6. Dielectric Couplings: Galvanized steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300 psig minimum working pressure at 225 deg F. temperature.
 - 7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive, thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 psig working pressure at 225 deg F. temperature.
- C. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet-Metal: 24 gauge or heavier, galvanized sheet metal, round tube closed with welding longitudinal joint.

2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
4. Cast-Iron Sleeve Fittings: Commercially-made, sleeve having integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22 Sections. Where more than single type is specified for listed application, selection is Installer's option, but provide single selection for each product category.

2.5 GROUT

- A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000 psi, 28-day compressive strength.
 3. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 22 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general locations and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

- C. Contractor is required to prime all plumbing traps with water prior to final inspections and in accordance with test procedures specified elsewhere.
- D. Install piping at indicated slope.
- E. Install components having pressure rating equal to or greater than system operating pressure.
- F. Install piping in concealed interior locations, except in equipment rooms and service areas.
- G. Install piping parallel and perpendicular free of sags, deflection, and bends.
- H. Install exposed interior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated and/or approved due to conditions.
- I. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal and needed access to other services. Allow for insulation thicknesses.
- J. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- K. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- L. Install fittings for changes in direction and branch connections.
- M. Install couplings according to manufacturer's printed instructions.
- N. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screws, and polished chrome-plated finish. Use split-casting escutcheons where required, for existing piping.
 - 2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.

5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.
- O. Sleeves are not required for core drilled holes.
- P. Install sleeves for piping passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated. Maintain fire assembly ratings.
- Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
 2. Build sleeves into new walls and slabs as work progresses.
 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6 inches.
 4. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal".
 - a. Seal space outside of sleeve fittings with non-shrink, non-metallic grout.
 5. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulations, using elastomeric joint sealants in Division 7 Section "Joint Sealants".
- R. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Division 7 Section "Firestopping".
- S. Verify final equipment locations for piping rough-in.
- T. Refer to equipment specifications in other sections of these Specifications for roughing-in requirements.
- U. Piping Joint Construction: Join pipe and fittings as follows and as specifically

required in individual piping system specification Sections.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS "Soldering Handbook," Chapter 6 "Assembly Processes."
 4. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
 - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
 - c. Align threads at point of assembly.
 - d. Tighten joints with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 5. Welded Joints: Construct joints according to AWS D10.12 "Guide for Welding Mild Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
- V. Piping Connections: Except as otherwise indicated, make piping connections as specified below:
1. Install unions in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2 inches or smaller threaded pipe connection.
 2. Wet Piping Systems (Water): Install dielectric couplings and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom, where mounting heights are not indicated.
- B. Install equipment according to manufacturer's installation instructions and

approved submittal data. Contractor assumes full responsibility for any and all items furnished and installed without written approval by the Architect or Engineer. Under no circumstances will a change order be approved for work installed that was not approved by the Architect or Engineer. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.

- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Allow for servicing and maintenance clearances.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

- A. Provide labeling per Division 22 specification sections for piping and equipment identification.

3.4 PAINTING AND FINISHING

- A. Refer to Division 9 Section "Painting" for field painting requirements.
- B. Damage and Touch-Up: Repair marred and damaged factory painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding - Steel."

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood ground, nailers, blocking, and anchorage to support and anchor plumbing materials and equipment.

- B. Select fastener sizes that will not 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 members.
- C. Attach to substrates as required to support applied loads.

3.7 DEMOLITION

- A. Disconnect, demolish, and remove Work specified under Division 22 and as indicated.
- B. Where pipe, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe in its entirety.
- D. Abandoned Work: Cut and remove indicated piping. Any piping indicated to be abandoned in place, cut back at least 2 inches beyond the face of adjacent construction, and terminate in an acceptable manner (plug or cap). Provide suitable filler material and patch surface to match existing finish.
- E. Removal: Remove indicated equipment and materials from the project site. Legally dispose of equipment and materials to local/regional regulations for type of debris.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation. Verify condition of item, make any necessary repairs to provide for full operation when reinstalled.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of the trades involved, using the proper tools and methods for penetrating construction. Protect adjoining areas from dust and debris, and any physical damage from operations. Schedule work accordingly not to affect other trades, occupants, Owners staff, etc.
- B. Repair cut surfaces in an acceptable manner to match adjacent surfaces, finishes, and maintain fire ratings of voided assembly where applicable.

END OF SECTION 220050

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SECTION 220523 - VALVES

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 general duty valves common to several mechanical piping systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Special purpose valves are specified in Division 22 piping system Sections.
 - 2. Valve tags and charts are specified in Division 22 Section "Plumbing Identification."

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.
- B. ASME Compliance: Comply with ASME B31.9 for building services piping and

ASME B31.1 for power piping.

- C. MSS Compliance: Comply with the various MSS Standard Practice Documents referenced.
- D. Valves shall be compatible with the type of piping material installed in the system.
- E. All domestic water valves shall meet the requirements of NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, grooves, and weld ends.
 - 3. Set globe and gate valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure to functional surfaces.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Gate Valves:
 - a. Hammond Valve Corporation.
 - b. Milwaukee Valve Company, Inc.
 - c. NIBCO Inc.
 - d. Stockham Valve & Fittings, Inc.
 - 2. Ball Valves:

- a. Conbraco Industries, Inc.; Apollo Division.
 - b. NIBCO Inc.
 - c. Stockham Valves & Fittings, Inc.
 - d. Watts Regulator Company.
3. Swing Check Valves:
- a. Hammond Valve Corporation.
 - b. Milwaukee Valve Company, Inc.
 - c. NIBCO Inc.
 - d. Stockham Valves & Fittings, Inc.
4. Balancing Valves:
- a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Div., ITT Fluid Technology Corp.

2.2 BASIC COMMON FEATURES

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Use specified operators and handwheels, except provide the following special operator features:
 - 1. Handwheels: For valves other than quarter turn.
 - 2. Lever Handles: For quarter-turn valves 6 inches and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- F. Threads: ASME B1.20.1.
- G. Solder Joint: ASME B16.18. Caution: Where soldered end connections are used, use solder having a melting point below 840° F for gate, globe, and check valves; below 421° F for ball valves.

2.3 GATE VALVES

- A. Gate Valves, 2-1/2 Inches and Smaller: Lead free MSS SP-80; Class 125, 200-psi cold working pressure (CWP), or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

2.4 BALL VALVES

- A. Ball Valves, 2 inches and Smaller: Lead free MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and full port for 3/4-inch larger; threaded or soldered end connections:
 - 1. Operator: Vinyl-covered steel lever handle.
 - 2. Stem Extension: For valves installed in insulated piping.
 - 3. Memory Stop: For operator handles.

2.5 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: Lead free MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections.

2.6 BALANCING VALVES

- A. Balancing Valves 1-1/2 Inches and Smaller: Lead free Bronze body, brass ball construction, TFE seat ring packing, differential pressure readout ports, straight pattern, globe type for throttling, tamper-proof "memory" stop with drain-purge port. 200 psig design pressure for sweat connection, 300 psig design pressure for threaded end connections.

2.7 DRAIN VALVES

- A. Ball Drain Valves: MSS SP-110, Class 150, 600-psi (4140-kPa) CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port valves; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections: NIBCO T-585-70 HC or equal.
 - 1. Operator: Vinyl-covered steel lever handle.
 - 2. Stem Extension: For valves installed in insulated piping.

3. Hose thread connection and brass cap with chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until satisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.

G. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joints, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.

3.6 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 1. Gate Valves: Lead free, Class 125, bronze or cast-iron body to suit piping system.
 2. Ball Valve: Lead free, Class 150, 600-psi CWP, with stem extension.
 3. Bronze Swing Check: Lead free, Class 125, with rubber seat.
 4. Check Valves: Lead free, Class 125, swing or wafer type as indicated.

3.7 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.8 VALVE SCHEDULE

Gate Valves - 2 Inch and Smaller:

MANUFACTURER	THREADED		SOLDER	
	NRS	RS	NRS	RS
Hammond	UP645	UP640	UP647	UP635
Milwaukee	UP105	UP148	UP115	UP149
NIBCO	T113-LF	T111-LF	S113-LF	S111-LF
Stockham	LFB-103	X	LFB-104	X

Ball Valves - 4 Inches and Smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Conbraco (Apollo)	77FLF-100	77FLF-200
NIBCO	T-585-80-LF	S-585-80-LF
Watts	LFB-6080	LFB-6081

Swing Check Valves - 2 Inches and Smaller:

MANUFACTURER	CLASS 125 THREADED ENDS	CLASS 150 SOLDER ENDS	THREADED ENDS
NIBCO	T-413-Y-LF	S-413-Y-LF	
Watts	LFCV	x	

x means not available.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS

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 hangers and supports for plumbing systems piping and equipment.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 5 Section "Metal Fabrications" for materials attaching hangers and supports to building structure.
 - 2. Division 22 Section "Vibration Control" for vibration-isolation hangers and supports.

1.3 DEFINITIONS

- A. Terminology used in this section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports for piping and equipment.
- B. Design seismic restraint hangers and supports for piping and equipment in accordance with, and obtain approval of, the authority having jurisdiction.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of hanger and support.

- C. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by the (Sub) Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.
- F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.
- G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code - Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
 - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.
- F. Licensed Engineer: Prepare hanger and support design drawings and calculations for seismic restraint of piping and equipment. Include seal and signature of

Registered Engineer, licensed in the jurisdiction where project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings where installed for piping and equipment that will not have field-applied finish.
 - 2. Pipe attachments include non-metallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with a sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, non-shrink, non-metallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic cement-type grout that is non-staining, non-corrosive, non-gaseous, and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable:
4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGERS AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments to support piping properly from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
- E. Support all insulated horizontal piping by means of hangers or supports with insulation shields installed outside of the insulation.
- F. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

- G. Install concrete inserts in new construction prior to placing concrete.
- H. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- I. Install mechanical anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- L. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach oversized clamps to suit the outside diameter of the pipe insulation, including spacers (if any), to piping so clamps do not project through insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install protective shields MSS Type 40 on cold, hot, recirculated hot, and storm water piping. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

<u>NPS</u>	<u>LENGTH</u>	<u>THICKNESS</u>
1/4 thru 3-1/2	12	0.048
4	12	0.060

4. Insert material shall be at least as long as the protective shield.
5. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.3 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standard D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required accommodating both expansion and contraction of piping.

3.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints and elsewhere as indicated.
- B. Anchor to building substrate.

3.5 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for piping and equipment.

3.6 METAL FABRICATION

- A. Cut, drill, fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 section "Painting" of these specifications.
- D. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 220529

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SECTION 220553 - PLUMBING IDENTIFICATION

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 plumbing identification materials and devices.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for identification materials and devices including catalog sheets, specifications and installation instructions for each item specified.
- C. Valve Schedules: Submit valve schedules for each piping system. Reproduce on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Furnish extra copies (in addition to mounted copies) for Maintenance Manuals as specified in Division 1 Section "Project Closeout."

1.4 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices after completion of covering and painting where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Products specified are manufacturer's standard products of categories and types required for each application as referenced in other Division 22 Sections. Where more than single type is specified for listed application, selections are Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate permanently fastened to equipment and having data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: An accessible and visible location.
- C. Pipes smaller than 6 Inches including insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.
- D. Pressure-Sensitive Pipe Markers: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.
- E. Lettering: Manufacturer's standard pre-printed terms which best describe each piping system, or as selected by Architect/Engineer in cases of variance with name as specified.
- F. Lettering: Use piping system terms as indicated and abbreviate only as necessary for each application length.
 - 1. Arrows: Either integrally with piping system service lettering (to accommodate both directions), or as separate unit, on each pipe marker to indicate direction of flow.
 - 2. Pipe Marker Legend and Color Field Sizes:

OD of Pipe or Insulation (Inches)	Letter Size (Inches)	Length of Color Field (Inches)
3/4 to 1-1/4 incl.	1/2	8
1-1/2 to 2 incl.	3/4	8

2-1/2 to 6 incl.	1-1/4	12
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- G. Plastic Tape: Manufacturer's standard color-coded, pressure- sensitive, self-adhesive, vinyl tape, at least 3-mils thick.
1. Width: 1-1/2 inches wide on pipes with outside diameters (including insulation) less than 6 inches; 2-1/2 inches wide for larger pipes.
 2. Color: Comply with ASME A13.1, except where another color selection is indicated.
- H. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.
- I. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Provide a 5/32- inch hole for fastener.
1. Material: 19 gauge polished brass
 2. Size: 1-1/2 inches diameter, except as otherwise indicated
- J. Valve Tag Fasteners: Brass chain (wire link or beaded type) or brass S-hooks.
- K. Access Panel Markers: 1/16-inch-thick engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.
- L. Valve Schedule Frames: Glazed display frame, with screws for removable mounting on masonry walls for each page of valve schedule, sized to fit 8-1/2x11 inches valve chart.
1. Frame: extruded aluminum
 2. Glazing: ASTM C 1036, 2.5 mm, single thickness, sheet glass
 - a. Type: Type I, flat transparent
 - b. Class: Class1, clear
 - c. Quality: Glazing B, for general applications
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine subcore, except when other colors are indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraved with engraver's standard letter style, of sizes and with terms to match equipment identification.
 2. Thickness: 1/16 inch, except as otherwise indicated.
 3. Fasteners: Self-tapping stainless steel screws or contact-type permanent adhesive.
- N. Plastic Equipment Markers: Laminated-plastic, in manufacturer's standard color code, unless otherwise indicated.
1. For hazardous equipment, use colors and designs recommended by ASME A13.1
 2. Terminology: Include following, matching schedules as closely as possible:
 - a. Name and plan number
 - b. Equipment service
 - c. Design capacity
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
 3. Size: Approximate 2-1/2 x 4 inches for valves; 4-1/2 x 6 inches for equipment.
- O. Plasticized Tags: Pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing.
1. Size: Approximately 3-1/4 x 5-5/8 inches.
 2. Fasteners: Brass grommets and wire.
 3. Nomenclature: Large-size primary wording such as "DANGER", "CAUTION", or "DO NOT OPERATE".
- P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in plumbing identification, with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of plumbing systems and equipment. Multiple Systems: Where multiple systems of same name are indicated, identify individual system number as well as service (such as Water Heater No.3, Air Compressor No.1A, or Standpipe F12).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Complete testing, insulation and finish painting Work prior to completing the

Work of this Section.

- B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.

3.2 INSTALLATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
- B. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- C. Plastic markers, with application systems.
 - 1. Fasten markers on pipes smaller than 6 inches including insulation where applicable by one of following methods:
 - a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap.
 - c. Laminated or bonded application of pipe marker to pipe (or insulation).
 - d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide, lapped 1-1/2 inches minimum at both ends of pipe marker, and covering full circumference of pipe.
 - 2. Fasten markers on pipes 6 inches and larger by one of following methods:
 - a. Laminated or bonded application of pipe marker to pipe (or insulation).
 - b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inches wide, lapped 3 inches minimum at both ends of pipe marker, and covering full circumference of pipe.
 - c. Strapped to pipe (or insulation) with manufacturer's standard stainless steel bands.
- D. Stick-On Pipe Markers:
 - 1. Install minimum of 2 markers at each specified location, 90 degrees apart on visible side of pipe.
 - 2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.
- E. Locate pipe markers and color bands as follows wherever piping is exposed in

finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
 2. Near each branch connection, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 3. Near penetrations through walls, floors, ceilings, or enter non-accessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- F. Valve Tags: Install valve tag on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, convenience and lawn-watering hose bibbs, and rough-in connections of end-use fixtures and units. List tagged valves in valve schedule. Install mounted valve schedule in each major equipment room.
- G. Equipment: Install engraved plastic laminate signs or equipment markers on or near each major item of plumbing equipment. Provide signs for following general categories of equipment:
1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 2. Meters, gages, thermometers, and similar units.
 3. Fuel-burning units including water heaters, stills, etc.
 4. Pumps, compressors, and similar motor-driven units.
 5. Heat exchangers, and similar equipment.
 6. Tanks and pressure vessels.
 7. Strainers, filters, water treatment systems, and similar equipment.

3.3 ADJUSTING AND CLEANING

- A. Relocate plumbing identification materials and devices which have become visually blocked by work of this Division or other Divisions.
- B. Clean face of identification devices and glass frames of valve charts.

3.4 PIPING IDENTIFICATION SCHEDULE

A. Piping Identification Types:

1. Piping or Insulation under 5-7/8 inch od: Pipe identification tags.
2. Piping or Insulation 3/4 inch to 5-7/8 inch od: Snap-on marker or stick-on marker.

B. Identify exposed piping, bare or insulated, as to content, size of pipe and direction of flow, with the following exceptions:

1. Piping in furred spaces or suspended ceilings, except at valve access panels where valves and piping shall be identified as specified for exposed piping systems.
2. Piping in finished spaces such as offices, class rooms, wards, toilet rooms, shower rooms and spaces as specified.

C. Locate piping identification to be visible from exposed points of observation. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs. Where 2 or more pipes run in parallel, place the printed legend and other markers in the same relative location.

3.5 VALVE IDENTIFICATION SCHEDULE

A. Tag valves according to size, shape, color scheme, and with captions to clearly and concisely indicate piping system and valve function.

B. Valve Service Identification Charts:

1. Provide 2 framed valve charts for each piping system specified to be provided with valve identification tags. Type charts on 8-1/2 x 11 inches heavy white bond paper, indicating valve number, service and location.
2. Hang framed charts at locations as directed.

END OF SECTION 220553

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SECTION 220719 - PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes pipe insulation.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 22 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.
- E. Density: Is expressed in lb/sq.ft.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and

Division 1 Specification Sections.

- B. Product data for each type of pipe insulation identifying k-value, thickness, and accessories.
- C. Material test reports prepared by a qualified independent testing laboratory. Certify that insulation meets specified requirements.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.
 - 1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
 - 2.

1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Glass Fiber:
 - a. CertainTeed Corporation.
 - b. Knauf Fiberglass GmbH.
 - c. Owens-Corning Fiberglas Corporation.
 - d. Schuller International, Inc.
 - e. USG Interiors, Inc. - Thermafiber Division.
 - 2. Flexible Elastomeric Cellular:
 - a. Armstrong World Industries, Inc.
 - b. Halstead Industrial Products.

- c. IMCOA.
- d. Rubatex Corporation.

2.2 GLASS FIBER

- A. Material: Inorganic glass fibers, bonded with a thermosetting resin.
- B. Jacket: All-purpose, factory-applied, laminated glass-fiber- reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.
- C. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
 - 1. Thermal Conductivity: 0.26 average maximum at 75 deg F mean temperature.
 - 2. Density: 10 average maximum.
- D. Adhesive: Produced under the UL Classification and Follow-up service.
 - 1. Type: Non-flammable, solvent-based.
 - 2. Service Temperature Range: Minus 20 to 180 deg F.
- E. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

- A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
- B. Form: Tubular materials conforming to ASTM C 534, Type I.
- C. Thermal Conductivity: 0.30 average maximum at 75 deg F.
- D. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 INSULATING CEMENTS

- A. Mineral Fiber: ASTM C 195.
 - 1. Thermal Conductivity: 1.0 average maximum at 500 deg F mean temperature.
 - 2. Compressive Strength: 10 psi at 5 percent deformation.

B. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.

1. Thermal Conductivity: 1.2 average maximum at 400 deg F mean temperature.
2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:

1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 JACKETS

A. General: ASTM C 921, Type 1, except as otherwise indicated.

B. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultra-violet-resistant PVC.

1. Adhesive: As recommended by insulation manufacturer.

2.7 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.

1. Tape Width: 4 inches.
2. Cloth Standard: MIL-C-20079H, Type I.
3. Tape Standard: MIL-C-20079H, Type II.

2.8 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

4. Water Vapor Permeance: 0.08 perm maximum.

5. Temperature Range: Minus 20 to 180 deg F.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
- B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with de-mineralized water. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping systems.
- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
- C. Install vapor barriers on insulated pipes having surface operating temperatures below 60 deg F.
- D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.
- E. Install insulation with smooth, straight, and even surfaces.
- F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.
- H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.
- I. Apply adhesives and coatings at the manufacturer's recommended coverage-per-

gallon rate.

- J. Keep insulation materials dry during application and finishing.
- K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
 - 1. Flexible connectors.
 - 2. Vent Piping
 - 3. Drainage piping located in crawl spaces, unless exposed to freezing conditions.
 - 4. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.
 - 5. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.
- L. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- M. Stagger joints on double layers of insulation.
- N. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- O. Apply insulation with a minimum number of joints.
- P. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Cover circumferential joints with butt strips, at least 3-inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.
 - 3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.
 - a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.
 - 4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and

- seal voids with vapor barrier coating.
6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.
- Q. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer. Refer to Division 7 Section "Joint Sealants."
- R. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer. Refer to Division 7 for firestopping and fire-resistant joint sealers.
- S. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor. Fill remaining annular space with fire sealant.
- T. Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
1. Use same material and thickness as adjacent pipe insulation.
 2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.
 3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
 4. Insulate elbows and tees smaller than 3-inches pipe size with premolded insulation.
 5. Insulate elbows and tees 3-inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
 6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
 7. Cover insulation, except for metal jacketed insulation, with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

- U. Hangers and Supports: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 22 Section "Hangers and Supports." For cold surface piping, extend insulation on anchor legs a minimum of 12 inches and taper and seal insulation ends. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.

3.3 GLASS FIBER INSULATION INSTALLATION

- A. Bond insulation to pipe with lagging adhesive.
- B. Seal exposed ends with lagging adhesive.
- C. Seal seams and joints with vapor barrier compound..

3.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION INSTALLATION

- A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.
- B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.
 - 1. Miter cut materials to cover soldered elbows and tees.
 - 2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for crewed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.5 JACKETS

- A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2-inch laps at longitudinal joints and 3-inch-wide butt strips at end joints. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.
- B. Interior Exposed Insulation: Install continuous PVC jackets.
- C. Install metal jacket with 2-inch overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.

- D. Install the PVC jacket with 1-inch overlap at longitudinal and butt joints and seal with adhesive.
- E. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2-inch overlap at joints. Embed glass cloth between (2) 1/16-inch-thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

3.6 FINISHES

- A. Paint finished insulation as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.7 APPLICATIONS

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.
- B. Interior, Exposed Piping Systems: Unless otherwise indicated, insulate the following piping systems:
 - 1. Domestic cold water.
 - 2. Domestic hot water.
 - 3. Tempered water.
 - 4. Recirculated hot water.
 - 5. Sanitary drains for fixtures accessible to the disabled.
 - 6. Soil and waste pipes exposed to freezing temperatures.
- C. Interior, Concealed Piping Systems: Unless otherwise indicated, insulate the following piping systems:
 - 1. Domestic cold water.
 - 2. Domestic hot water.
 - 3. Tempered water.
 - 4. Recirculated hot water.
 - 5. Soil and waste pipes exposed to freezing temperatures.

3.8 PIPE INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel.
2. Pipe Sizes: NPS - Nominal Pipe Size.

<p style="text-align: center;"><u>INTERIOR DOMESTIC COLD WATER</u></p> <p style="text-align: center;">INSULATION SCHEDULE</p> <p>Insulating materials and thickness for piping, equipment, vessels and appurtenances for conveying, storing or processing materials. Thicknesses listed are minimum (Nominal).</p>			
PIPE SIZES (NPS)	MATERIAL OPTIONS	VAPOR BARRIER	INSULATION THICKNESS (Inches)
1/2 to 1"	Fibrous Glass or Flex. Elastomeric Foam	Yes	1"
1-1/4" and up	Fibrous Glass or Flex. Elastomeric Foam	Yes	1"

<p style="text-align: center;"><u>100• F TO 139• F</u></p> <p style="text-align: center;"><u>INTERIOR DOMESTIC HOT WATER & RE CIRCULATION HOT WATER</u></p> <p style="text-align: center;">INSULATION SCHEDULE</p> <p>Insulating materials and thickness for piping, equipment, vessels and appurtenances for conveying, storing or processing materials. Thicknesses listed are minimum (Nominal).</p>			
PIPE SIZES (NPS)	MATERIAL OPTIONS	VAPOR BARRIER	INSULATION THICKNESS (Inches)
1/2 to 1-1/4"	Fibrous Glass or Flex. Elastomeric Foam	Yes	1"
1-1/2 to up	Fibrous Glass or Flex. Elastomeric Foam	Yes	1-1/2"

<p style="text-align: center;"><u>INTERIOR STORM WATER</u></p> <p style="text-align: center;">INSULATION SCHEDULE</p> <p>Insulating materials and thickness for piping, roof drain bodies, and appurtenances for conveying, storing or processing materials. Thicknesses listed are minimum (Nominal).</p>			
PIPE SIZES (NPS)	MATERIAL OPTIONS	VAPOR BARRIER	INSULATION THICKNESS (Inches)
2" to 6"	Fibrous Glass or Flex. Elastomeric Foam	Yes	1"
8" and up	Fibrous Glass or Flex. Elastomeric Foam	Yes	1-1/2"

<p style="text-align: center;"><u>SOIL & WASTE PIPING EXPOSED TO FREEZING CONDITIONS</u></p> <p style="text-align: center;">INSULATION SCHEDULE</p> <p>Insulating materials and thickness for water, soil & waste pipes installed in attics, crawl spaces, garages, concealed in outside walls or any other place subjected to freezing temperatures. Thicknesses listed are minimum (Nominal).</p>			
PIPE SIZES (NPS)	MATERIAL OPTIONS	VAPOR BARRIER	INSULATION THICKNESS (Inches)
2" to 6"	Fibrous Glass or Flex. Elastomeric Foam	Yes	1"
8" and up	Fibrous Glass or Flex. Elastomeric Foam	Yes	1-1/2"

3.9 SANITARY DRAINS AND SUPPLIES EXPOSED AT FIXTURES FOR DISABLED

- A. Contractor shall install pre-formed supply and trap covers, as specified in Section 224200.

END OF SECTION 220719

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SECTION 220800 - COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. This section includes general requirements that apply to implementation of the commissioning process without regard to specific systems, assemblies, and components.
- B. Related Sections including the following:
 - 1. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC systems, assemblies, equipment, and components.
 - 2. Division 26 Section "Commissioning of Electrical" for commissioning process activities for electrical systems, assemblies, equipment and components.

1.3 DEFINITIONS

- A. BoD: Basis of Design. A document, prepared by Architect, that record concepts, calculations, decisions, and product selection used to meet the OPR and to satisfy applicable regulator requirements, standard and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document, prepared by CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document, prepared by Owner that

details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

- E. Systems, Assemblies, Equipment and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documents to the CxA and each Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor and their subcontractors shall assign representatives with expertise and authority to act on their behalf and schedule them to participate in and

perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in "Issues Log."
3. Attend and participate in commissioning team meetings held on a variable basis.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklist provided by the commissioning authority.
6. Complete paper or electronic construction checklists as Work is completed and provide to the commissioning authority on a monthly basis.
7. Review and accept commissioning process test procedures provided by the commissioning authority.
8. Accomplish commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, CxA will report the failure in the "Issue Log."
- F. Prepare and maintain issues log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.

- I. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 SYSTEMS TO BE COMMISSIONED

- A. Systems to be commissioned shall include, but not limited to the following systems and equipment. Contractor shall coordinate with the commissioning agents Cx plan for a complete list of systems and equipment.
 1. Service Water Heating and Domestic Hot Water systems including, but not limited to:
 - a.faucets
 - b.HWR Balancing Stations

END OF SECTION 220800

SECTION 221113 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes potable cold water, hot water, and circulation hot water piping, fittings, and specialties within the building to a point 5 feet outside the building.
- B. Related Sections: The following Sections contain requirements that relate to this section.
 - 1. Division 7 Section "Joint Sealers" for materials and methods for sealing pipe penetrations through basement walls and fire and smoke barriers.
 - 2. Division 22 Section "Valves."
 - 3. Division 22 Section "Meters and Gages" for thermometers and pressure gages.
 - 4. Division 22 Section "Plumbing Identification" for labeling and identification of piping system.

1.3 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.
- C. Pipe sizes used in this Specification are nominal pipe size (NPS).

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

- B. Product data for each piping specialty and valve specified.
- C. Welder Certificates signed by (Sub)Contractor certifying that welders comply with requirements specified in "Quality Assurance" Article.
- D. Certification of Compliance with ASME and UL fabrication requirements specified below.
 - 1. Test reports specified in Part 3 of this Section.
 - 2. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section - "Basic Mechanical Requirements."

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with the provisions of the following codes:
 - 1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.
 - 3. New York State Department of Health "Public Water Supply Guide for Cross Connection Control" for installation of backflow prevention devices.
 - 4. Federal Public Law 111-380 ANSI 372 to amend the Safe Drinking Water Act to reduce lead in drinking water. "(B) not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store pipe in a manner to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.8 EXTRA MATERIALS

- A. Maintenance Stock: Furnish one valve key for each key-operated hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Balancing Valves:
 - a. Nibco, Inc.
 - b. Bell & Gossett
 - 2. Water Hammer Arresters:
 - a. Amtrol, Inc.
 - b. Josam Co.
 - c. Precision Plumbing Products, Inc.
 - d. Smith (Jay R.) Mfg. Co.
 - e. Wade Div., Tyler Pipe.
 - f. Watts Regulator Co.
 - g. Zurn Industries, Inc.; Hydromechanics Div.
 - 3. Press Fittings For Copper Pipe:
 - a. Viega Corp., Rigid Tool Co.
 - 4. Mechanical Couplings and Fittings For Grooved-End Steel Pipe:
 - a. Grinnell Corp.
 - b. Gustin-Bacon Div., Tyler Pipe
 - c. Stockham Valves & Fittings, Inc.
 - d. Victaulic Co. of America.
 - 5. Mechanical Couplings and Fittings For Grooved-End Copper Tube:
 - a. Victaulic Co. of America.
 - 6. Vacuum Breakers For Hose Connections:

- a. Cash (A.W.) Valve Mfg. Corp.
- b. Conbraco Industries, Inc.
- c. Watts Regulator Co.

2.2 PIPE AND TUBE MATERIALS, GENERAL

- A. Pipe and Tube: Refer to Part 3, Article "Application, General," for identification of systems where the below materials are used.
 - 1. Copper Tube: ASTM B 88, Type L Water Tube, drawn temper.
 - 2. Copper Tube: ASTM B 88, Type K Water Tube, annealed temper.

2.3 FITTINGS

- A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.
- B. Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.
 - 1. Copper Press Fittings Manufacturer: Viega Corporation, Rigid Tool Co.
- C. Mechanical Couplings For Grooved-End Piping: Ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design, with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe or tube and fittings. Couplings for use with AWWA Dimension piping shall conform to AWWA C606.
- D. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.
- E. Unions: ASME B16.39, malleable iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces, female threaded ends. Threads shall conform to ASME B1.20.1.
- F. Dielectric Unions: Threaded, solder, or grooved-end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.
- G. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze wire reinforced protective jacket; minimum 150 psig working pressure, maximum 250 deg F operating temperature. Connectors shall have flanged or threaded-end

connections to match equipment connected and shall be capable of 3/4-inch misalignment.

2.4 JOINING MATERIALS

- A. Solder Filler Metal: ASTM B 32, 95-5 Tin-Antimony.
- B. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.5 GENERAL-DUTY VALVES

- A. General-duty valves (i.e., gate, check, and ball valves) are specified in Division 22 Section "Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "Valve Application" for specific uses and applications for each valve specified.

2.6 SPECIAL DUTY VALVES

- A. Balance Valves - 1-1/4" and smaller: Bronze body, brass ball construction, TFE seat ring packing, differential pressure readout ports, straight pattern, globe type for throttling, tamper-proof "memory" stop with drain-purge port. 230 psig for threaded fitting 200 psig for sweat connection.

2.7 PIPING SPECIALTIES

- A. Water Hammer Arresters: Bellows type, with stainless steel casing and bellows, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.
- B. Basket Strainers: Cast-iron body, 125 psi flanges, bolted-type or yoke-type cover with removable noncorrosive perforated strainer basket having 1/8-inch perforations and lift-out handle.
- C. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.
 - 1. Hose Bibbs: Lead free bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- D. Vacuum Breakers: Hose connection vacuum breakers shall conform to ASSE

Standard 1011, with finish to match hose connection.

- E. Pressure-Regulating Valves: Single-seated, direct-operated type, having bronze body with integral strainer and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.
- F. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
- G. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 deg F, and pressure relief at 150 psi.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine rough-in requirements for plumbing fixtures and other equipment with water connections to verify actual locations of piping connections prior to installation.

3.1 PIPE APPLICATIONS

- A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 4 inches and smaller, above ground, within building. Install Type K, annealed temper copper tube for pipe sizes 2 inches and smaller, with minimum number of joints, below ground.
- B. Water piping in sizes 2-1/2 to 2 inches may be Type L drawn copper tube with roll-grooved ends and mechanical couplings, above ground, within building.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

- B. Use fittings for all changes in direction and branch connections.
- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls with sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inches shall be galvanized steel pipe; pipe sleeves 6 inches and larger shall be galvanized steel sheet metal.
- J. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 7 for special sealers and materials.
- K. Install piping level with no pitch.

3.3 HANGERS AND SUPPORTS

- A. General: Hanger, support, and anchor devices conforming to MSS SP-69 are specified in Division 22 Section "Hangers and Supports." Conform to the table below for maximum spacing of supports:
 - 1. Pipe Attachments: Install the following:
 - a. Adjustable steel clevis hangers, MSS Type 1, for individual horizontal runs less than 20 feet in length.

- b. Adjustable roller hangers, MSS Type 43, and spring hangers, MSS Type 41 with Type 49, for individual horizontal runs 20 feet and longer.
 - c. Pipe roll, complete MSS Type 44 for multiple horizontal runs, 20 feet or longer, support on a trapeze.
 - d. Spring hangers to support vertical runs.
- B. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

PIPING SUPPORT SPACING

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
Copper or copper-alloy pipe	12	10
Copper or copper-alloy tubing, 1-1/4" dia. and smaller	6	10
Copper or copper-alloy tubing, 1-1/2" dia. and larger	10	10

HANGER ROD SIZING

Nom. Pipe Size (Inches)	Steel Pipe Max. Span (Feet)	Copper Tube Max. Span (Feet)	Min. Rod Dia. (Inches)
Up to 3/4	6	5	3/8
1	6	6	3/8
1-1/4	7	6	3/8
1-1/2	9	10	3/8
2	10	10	3/8
2-1/2	11	10	1/2
3	12	10	1/2
3-1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)

HANGER ROD SIZING

Nom. Pipe Size (Inches)	Steel Pipe Max. Span (Feet)	Copper Tube Max. Span (Feet)	Min. Rod Dia. (Inches)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)

- C. Support vertical steel pipe and copper tube at each floor.
- D. Support plastic pipe and tubing in accordance with manufacturer's recommendations.

3.4 PIPE AND TUBE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
- C. Fill the tubing and fittings during soldering and brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
- D. Heat joints to proper and uniform temperature.
- E. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:
- F. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
- G. Align threads at point of assembly.
- H. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
- I. Assemble joint wrench tight. Wrench on valve shall be on the valve end into

which the pipe is being threaded.

- J. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- K. Grooved-End Joints: Prepare pipe and tubing and install in accordance with manufacturer's installation instructions.
- L. Press connections: Copper press fittings shall be made in accordance with manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

3.5 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shut-off duty: Use gate, ball, and butterfly valves.
 - 2. Throttling duty: Use globe, ball, and butterfly valves.

3.6 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use gate or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use gate or butterfly

valves.

- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.
- E. Balance Valves: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.
- F. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.

3.7 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
- B. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
- C. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
- D. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.

- E. Reports: Prepare inspection reports signed by the plumbing official.
- F. Test water distribution piping as follows:
 - 1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for all tests and required corrective action.

3.9 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 - 2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
 - 3. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - 4. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - 5. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - 6. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.

7. Contractor shall submit water samples in sterile bottles to a New York State Department of Health approved laboratory. Repeat the procedure if the biological examination made by the lab shows evidence of contamination. Test results shall be furnished to the engineer.
8. Prepare reports for all purging and disinfecting activities.

3.10 COMMISSIONING

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:
 1. Close drain valve, hydrants, and hose bibbs.
 2. Open valves to full open position.
 3. Remove and clean strainers.
 4. Check pumps for proper direction of rotation. Correct improper wiring.
 5. Lubricate pump motors and bearings.

END OF SECTION 221113

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SECTION 221310 – DRAINAGE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
 - 2. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.

1.3 DEFINITIONS

- A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect

trap seals from siphonage and back pressure.

1.4 SUBMITTALS

A. Product data for the following products:

1. Drainage piping specialties.
2. Floor drains.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: comply with the provisions of the following:

1. International Plumbing Code Adopted by NYS.

B. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of roof drains, flashing, and roof penetrations with other trades.
- B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.
- C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.
- D. Coordinate with installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems and work of other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drainage and vent systems which may be incorporated in the work include, but are not limited to, the following:

B. Drainage Piping Specialties, including, drains, and trap primers:

1. Josam Mfg. Co.
2. Smith (Jay R) Mfg. Co.
3. Tyler Pipe; Subs. of Tyler Corp.
4. Zurn Industries Inc; Hydromechanics Div.
5. Watts Drainage Products; Division of Watts Regulator

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Copper Tube: ASTM B306, Type DWV for pipe, and cast-bronze, drainage pattern fittings, with soldered joints.
- B. Solder Filler Materials: ASTM B32, 50-50 tin-lead solder.
- C. Cast-Iron Soil Pipe: ASTM A74, CISPI HS 74, Service weight, hub-and-spigot soil pipe and fittings.
- D. Compression gaskets: ASTM C564.
- E. Hubless Cast-Iron Soil Pipe: CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with clamps and neoprene gaskets conforming to CISPI Standard 310.

2.3 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: ASTM A74, CISPI HS 74, Service weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.
- B. Neoprene Compression Gaskets: ASTM C564.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Trap Primers: Bronze body valve with automatic vacuum breaker, with 1/2 inch connections matching piping system. Complying with ASSE 1018.
- B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
- C. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

- D. Floor Cleanouts: Cast-iron body and frame, with cleanout plug and adjustable round top as follows:
 - 1. Nickel-Bronze Top: Manufacturer's standard cast unit with the following patterns:
 - 2. Exposed flush type, standard non-slip scored or abrasive finish.
- E. Cast-iron Top: Manufacturer's standard cast unit with the following patterns:
 - 1. Wall Cleanouts: 7" diameter stainless steel cover including screw.
 - 2. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

2.5 FLOOR DRAINS

- A. Floor drain type designations and sizes are indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with compacted, clean sand or pea gravel to indicated

invert elevation.

- C. Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

- A. Install copper tube with cast bronze fittings for 3 inch and smaller, drainage and vent pipe.
- B. Install hub-and-spigot, service weight, cast-iron soil pipe with compression gasket joints for larger than 1-1/2-inch drainage and vent pipe.
- C. Install hubless, service weight, cast-iron soil pipe and fittings for larger than 1-1/2-inch drainage and vent pipe.

3.4 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller drainage pipe.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- B. Cast-Iron Soil Pipe: Make compression joints and hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV

3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs

are not permitted, unless expressly indicated.

- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.
- H. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited
- I. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- J. Install building drain pitched down at minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.
- K. Extend building drain to connect to sewer piping, of size and in location indicated for service entrance to building. Sewer piping is specified in a separate section of

Division 2.

- L. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.
- M. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12 inch beyond each side of pipe. Install directly over, and center on pipe center line.

3.7 HANGERS AND SUPPORTS

- A. General: Hanger, supports, and anchors devices are specified in Division 22 Section "Basic Mechanical Materials and Methods." Conform to the table below for maximum spacing of supports:
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
- C. Install hangers at the following intervals:

PIPING SUPPORT SPACING

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
ABS pipe	4	10
Cast-iron pipe	5	15
Copper or copper-alloy tubing, 1-1/4" dia. and smaller	6	10
Copper or copper-alloy tubing, 1-1/2" dia. and larger	10	10

HANGER ROD SIZING

Nom. Pipe Size (Inches)	Steel Pipe Max. Span (Feet)	Copper Tube Max. Span (Feet)	Min. Rod Dia. (Inches)
Up to 3/4	6	5	3/8
1	6	6	3/8
1-1/4	7	6	3/8
1-1/2	9	10	3/8
2	10	10	3/8
2-1/2	11	10	1/2
3	12	10	1/2
3-1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)

- D. Support vertical copper tube at each floor.

3.8 INSTALLATION OF PIPING SPECIALTIES

- A. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
as required by plumbing code;
at each change in direction of piping greater than 45 degrees;
at minimum intervals of 100';
at base of each vertical soil or waste stack;
flush with floor finish for interior installations;
flush with grade for exterior installations.
- B. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- C. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

3.9 INSTALLATION OF FLOOR DRAINS

- A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.
- B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
- C. Set drain elevation depressed below finished slab elevation as listed below to provide proper slope to drain:

<u>DEPRESSION IN INCHES</u>	<u>RADIUS OF AREA DRAINED- FEET</u>
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Trap all drains connected to the sanitary sewer.
- E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are accessible and easy to maintain.

3.10 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.11 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
- B. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
- C. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
- D. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
- E. Reports: Prepare inspection reports, signed by the plumbing official.
- F. Piping System Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
- G. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
- H. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
- I. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
- J. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it

leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

- K. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
- L. Prepare reports for all tests and required corrective action.

3.12 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.13 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION 221310

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SECTION 224200 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Valves" for valves used as supply stops.
- C. Products furnished but not installed under this Section include:
 - 1. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment provided by Owner.
 - 2. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment specified in other sections.
- D. Products installed but not furnished under this Section include:
 - 1. Owner-supplied fixtures, as indicated.
 - 2. Accessories, appliances, appurtenances, and equipment specified in other sections, requiring plumbing services or fixture-related devices, as indicated.

1.3 DEFINITIONS

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience, or improved appearance

to a fixture but is not essential to its operation.

- C. Appliance: Device or machine designed and intended to perform a specific function.
- D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.
- G. Fixture: Installed receptor connected to the water distribution system, that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.
- H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
 - 1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
 - 2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
 - 3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
 - 4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.
- J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.
- C. Wiring diagrams for field-installed wiring of electrically operated units.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of ANSI Standard ICC/A117.1-2017, "Accessible and Usable Buildings and Facilities" with respect to plumbing fixtures for the physically handicapped.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other specified manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.
- B. Store plumbing fixtures on elevated platforms in a dry location.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
1. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
 2. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.
 3. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.
 4. Provide a hinged-top wood or metal box, or individual metal boxes, having a separate compartment for each type and size of above extra materials.
 5. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Water Closets:
 - a. American Standard Brand.
 - b. Crane Plumbing/American Standard Brand.
 - c. Eljer/American Standard Brand.
 - d. Gerber Plumbing Fixtures LLC.
 - e. Kohler Co.
 - f. Mansfield Plumbing Products, Inc.
 - g. Universal-Rundle Corp.
 2. Lavatories:
 - a. Acorn Engineering Co.
 - b. American Standard Brand.
 - c. Crane Plumbing/American Standard Brands.
 - d. Eljer/American Standard Brand.
 - e. Gerber Plumbing Fixtures, LLC.
 - f. Just Manufacturing Co.

- g. Kohler Co.
 - h. Mansfield Plumbing Products, Inc.
 - i. Universal-Rundle Corp.
- 3. Sinks:
 - a. American Standard Brand.
 - b. Crane Plumbing/American Standard Brands.
 - c. Eljer/American Standard Brand.
 - d. Elkay Manufacturing Co.
 - e. Just Manufacturing Co.
 - f. Kohler Co.
 - g. Moen Incorporated.
 - h. Universal-Rundle Corp.
- 4. Outlet Boxes:
 - a. Guy Gray/IPS Corporation.
 - b. Oatey
 - c. Symmons Industries, Inc.
- 5. Toilet Seats:
 - a. Bemis Mfg. Co.
 - b. Church Seat Co.
 - c. Kohler Co.
 - d. Olsonite Corp.
- 6. Flushometers:
 - a. Cambridge Brass.
 - b. Delany Products.
 - c. Sloan Valve Co.
 - d. Hydrotek International Inc.
 - e. Zurn Industries, LLC.
- 7. Commercial/Industrial Cast-Brass Faucets:
 - a. American Standard Brand.
 - b. Briggs Plumbing.
 - c. Chicago Faucet Co.
 - d. Crane Plumbing/American Standard Brand.
 - e. Eljer/American Standard Brand.
 - f. Fisher Manufacturing Co.
 - g. Grohe America, Inc.
 - h. Kohler Co.
 - i. Speakman Co.

- j. T & S Brass and Bronze Works, Inc.
- 8. Miscellaneous Fittings (Except Faucets):
 - a. Brass Craft Manufacturing Company.
 - b. Central Brass/Pioneer Industries, Inc.
 - c. Chicago Faucet Co.
 - d. Crane Plumbing/American Standard Brand.
 - e. Eljer/American Standard Brand.
 - f. Kohler Co.
 - g. McGuire Manufacturing Co., Inc.
 - h. Pfister/Spectrum Brands.
 - i. T & S Brass and Bronze Works, Inc.
- 9. Supports:
 - a. Josam Co.
 - b. Jay R. Smith Mfg. Co.
 - c. Wade Div.; McWane Inc.
 - d. Ancon, Inc.
 - e. Zurn Industries, LLC.
- 10. Sanitary Joint Sealant:
 - a. Pecora Corp.
 - b. GE Silicone: Sanitary 1700

2.2 PLUMBING FIXTURES, GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified in "Plumbing Fixture Data Sheets" at the end of Part 3 of this Section.

2.3 FAUCETS

- A. Faucets General: Unless otherwise specified, provide faucets that are cast brass with polished chrome-plated finish.

2.4 FITTINGS, EXCEPT FAUCETS

- A. Fittings General: Unless otherwise specified, provide fittings fabricated of brass, with a polished chrome plated finish.

2.5 FLUSHOMETERS

- A. Provide flushometers compatible with fixtures, with features and of consumption indicated.
- B. Construction: Cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker, and brass lever handle actuation except where other variations are specified. Type shall be diaphragm operation with dual filtered bypass except where other type is specified.
- C. Finish: Exposed metal parts shall be polished chrome-plated, except components installed in a concealed location may be rough brass or unfinished.

2.6 TOILET SEATS

- A. General: Provide toilet seats compatible with water closets, and of type, color, and features indicated.

2.7 PLUMBING FIXTURE SUPPORTS

- A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.
- B. Support categories are:
 - 1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
 - 2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
 - 3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
 - 4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.
- C. Support Types: Provide support of category specified, of type having features required to match fixture.
- D. Provide supports specified as part of fixture description, in lieu of category and

type requirements above.

2.8 SANITARY JOINT SEALANT

- A. One-part, Mildew-resistant Silicone Sealant:. Manufacturer's standard, non-modified, single component, acid-curing, silicone sealant. Sealant shall comply with ASTM C920, Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to non-porous joint substrates indicated, Use O. Sealant shall be formulated with fungicide and specifically intended for sealing interior joints with non-porous substrates and subject to in-service exposure to high humidity and temperature extremes.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 APPLICATION

- A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.
- B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
 - 1. Carriers for following fixtures:
 - a. Wall-hanging water closets.
 - b. Wall-hanging fixtures supported from wall construction.
 - 2. Chair carriers for the following fixtures:
 - a. Wall-hanging urinals.
 - b. Wall-hanging lavatories and sinks.
 - c. Wall-hanging drinking fountains and electric water coolers.
 - 3. Heavy-duty chair carriers for the following fixtures:

- a. Accessible lavatories.
- b. Fixtures where specified.
- 4. Reinforcement for the following fixtures:
 - a. Floor-mounted lavatories required to be secured to wall.
 - b. Floor-mounted sinks required to be secured to wall.
 - c. Recessed, box-mounted electric water coolers.

3.03 INSTALLATION OF PLUMBING FIXTURES

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.
- B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.
- C. At accessible water closets and urinals, install flush valves with handles oriented toward approach side of stall.
- D. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- E. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- F. Fasten wall-mounted fittings to reinforcement built into walls.
- G. Fasten counter-mounting-type plumbing fixtures to casework.
- H. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- I. Install stop valve in an accessible location in each water supply to each fixture.
- J. Install trap on fixture outlet except for fixtures having integral trap.
- K. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- L. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements

specified in Division 7 Section "Joint Sealers." Match sealant color to fixture color.

3.04 CONNECTIONS

- A. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.
 - 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.05 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.06 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.
- D. Replace washers of leaking and dripping faucets and stops.
- E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.
- F. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by the Owner.

3.08 FIXTURE SCHEDULE

- A. Provide plumbing fixtures as scheduled on the "Plumbing Fixture schedule, on the drawings.

3.09 ROUGH-IN SCHEDULE

<u>FIXTURE</u>	<u>HOT WATER</u>	<u>COLD WATER</u>	<u>WASTE</u>	<u>VENT</u>
Lavatory	1/2"	1/2"	1-1/2"	1-1/2"
Flush Valve Water Closet	-	1"	4"	2"
Sink	1/2"	1/2"	1-1/2"	1-1/2"

3.10 MOUNTING HEIGHTS SCHEDULE

<u>FIXTURE</u>	<u>MOUNTING HEIGHT</u>
Handicapped Accessible Lavatory	34" floor to rim
Handicapped Accessible Water Closet	17" floor to rim

END OF SECTION 224200

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SECTION 230000 - SCOPE OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All work under this title, on drawings or specified, is subject to the architectural general and special contract conditions for the entire project, and the contractor for this portion of the work is required to refer especially thereto, and to the architectural drawings.

1.2 SCOPE OF WORK

- A. The following is a general listing of work items to be provided under this Contract. Work indicated is not necessarily all inclusive, nor shall it limit the extent of the work or exclude any work shown or specified and not listed.
- B. This Contractor shall refer to Division 1 for additional scope items required by Contract including but not limited to the section listed as "Summary of Work, Multiple Prime Contracts".
- C. Contractor shall furnish all materials, equipment and labor to make the following complete installations:
 - 1. All mechanical demolition work as indicated on Drawings and as specified including but not limited to the complete removal and proper disposal of material and equipment from the site.
 - 2. Mechanical identification as required by the specifications including but not limited to pipe identification, duct identification and equipment identification.
 - 3. Sleeves and plates including fire stop material.
 - 4. Cutting and patching required to accomplish the work indicated including painting and finish work.
 - 5. Pipe, fittings, hangers, supports, core drilling, anchors, valves, piping specialties and accessories required to make complete installation of heating hot water, refrigeration piping system, steam and steam condensate piping systems, and condensate drain systems.
 - 6. Vibration isolators and accessories.
 - 7. Complete hydronic air control system including but not limited to manual air vents.
 - 8. Cabinet heaters (hydronic, steam & electric) complete with fans, coil sections, drain pans, casing, motors, valves, filters, controls and accessories.

9. Variable Flow Refrigerant (VRF) system complete with indoor fan coil units, outdoor condensing unit, heat recovery branch boxes, controls and accessories.
10. Finned tube radiation (hydronic & electric) including fin element, enclosure, brackets and accessories required for a complete installation.
11. Diffusers, registers and grilles complete with dampers, insulated plenum boxes, and accessories.
12. Gravity intake roof ventilator complete with screens, curbs and accessories.
13. Ductwork to include galvanized sheetmetal to service outside, supply and return and exhaust air duct systems complete with flexible duct and flexible connectors, brick vents, air control devices, fire and smoke dampers, access doors and accessories.
14. Thermal and acoustic insulations to service piping and ductwork complete with pins, jackets, adhesive, tape and accessories.
15. Provide motor controls and motor starters for all HVAC equipment.
16. DDC temperature controls to serve all heating, ventilating and air conditioning equipment installed, complete with dampers, motor actuators, controllers, wiring systems and all accessories.
17. Testing, start-up and balancing of all heating, ventilating and air conditioning installations to include sheetmetal ductwork, air handling supply, return and exhaust systems, heating and cooling systems and temperature control systems. Balancing work shall include rebalancing the existing air distribution system.
18. Servicing of heating, ventilating and air conditioning equipment installed as required during guarantee period for a minimum of 1 year after Owner's acceptance.
19. Provide competent factory-trained personnel at site for the purpose of instructing Owner's personnel in proper operation and maintenance of all new HVAC facilities.

END OF SECTION 230000

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PLANS AND SPECIFICATIONS

- A. All work under this title, on drawings or specified, is subject to the general and special contract conditions for the entire project, and the contractor for this portion of the work is required to refer especially thereto, and to the architectural drawings.
- B. Drawings are diagrammatic in nature and specifications are complementary and must be so interpreted to determine the full scope of work under this heading. Wherever any material, article, operation or method is either specified or shown on the drawings, this contractor is required to provide each item and perform each prescribed operation according to the designate quality, qualification or condition, furnishing all necessary labor, equipment or incidentals.
- C. Wherever the designation "Architect" appears, it shall imply Architect or Engineer. Wherever the term "Contractor" or "HC" appears, it shall imply the Contractor responsible for Division 23, HVAC work.

1.3 CONFLICTS

- A. If, in the interpretation of contract documents, it appears that the drawings and specifications are not in agreement, the Contractor is to contact the Engineer. The Engineer shall be the final authority. Addenda supersede the provisions which they amend.
- B. In the absence of a written clarification by the engineer, the Contractor must install his work in accordance with the more stringent and/or costly condition. Contractor assumes full responsibility for any and all items furnished and installed without the written approval by the Architect or Engineer. Under no circumstances will a change order be accepted for work installed that was not approved by the Architect or Engineer.

1.4 DIMENSIONS, LAYOUTS AND OBSTACLES

- A. Verify dimensions and elevations from actual field measurements after building construction has sufficiently progressed.
- B. Assume full and final responsibility for the accuracy of any or all work performed under this Division and make repairs and corrections as required or directed at no extra cost to the Owner.
- C. Layouts of piping, ductwork, and equipment shown on drawings are

diagrammatic and shall be construed as such. DO NOT SCALE DRAWINGS. Contractor shall field verify all existing conditions prior to fabrication and installation of material. It is recommended that the contractor verify all existing conditions prior to submitting a proposal. Lack of field verification does not constitute a basis for additional monies during construction. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.

- D. Make actual installations in accord with said layouts, but with necessary deviations as directed or required by job conditions and field measurements in order to produce a thoroughly integrated and practical job upon completing, but make deviations only with specific approval of the Engineer/Architect.
- E. Take particular care to coordinate all piping and ductwork under this Division to prevent conflict and remove and relocate work as may be made necessary by such conflict at no extra cost to the Owner.
- F. Unless expressly permitted by the Engineer/Architect or shown otherwise on the Drawings, all piping, ducts and similar items shall be installed so that they are concealed except as permitted by the Engineer/Architect in service rooms noted on the Drawings.
- G. The Owner or Owner's Representative reserves the right to relocate terminal equipment six (6) feet in any direction from locations indicated on plans, before roughing-in, with no change in contract price.

1.5 REVIEW OF MATERIAL

- A. Items specified have been checked by the Engineer for performance and space limitation.
- B. In order for Engineer to consider "equal", HC must certify by letter that he has checked the product for conformance to specifications and space limitations and assumes full responsibility thereafter.
- C. Engineer, not Contractor or Vendor, shall be the final judge of equal materials.
- D. Substitutions are defined as any manufacturer and/or model not indicated in drawings or specifications. Requests for substitutions must be made in writing ten (10) days prior to bid date so that an addendum may reach all contractors.
- E. If substitutions are proposed after the bids are received, the Contractor shall state amount of credit to the Owner for substitution. Substitutions that are considered equal by the Contractor and carried in bid without approval by Engineer shall be the responsibility of the Contractor. The Engineer and/or Owner shall not be made liable or responsible for losses incurred by the Contractor, due to the rejection of said items for installation.
- F. Where equipment requiring different arrangement or connections other than as indicated is acceptable, it shall be the responsibility of this Contractor to furnish revised layouts and install the equipment to operate properly and in harmony with the intent of the drawings and specifications. All changes in the work required by the different arrangement shall be done at no additional cost to the Owner, including but not limited to structural steel modifications. Control and

power wiring modifications required by Contractor, imposed modifications, and the additional cost of these modifications, shall be the responsibility of this Contractor.

- G. Upon review of equipment list by Engineer, copies of submittal prints shall be forwarded to Engineer within 30 days.

1.6 PERMITS, CODES AND ORDINANCES

- A. The Heating Contractor shall arrange and pay for all permits, inspections, etc., as required by local utilities or applicable agencies.
- B. All work and material shall be in complete accordance with the ordinances, regulations, codes, etc., of all political entities exercising jurisdictions, specifically including the NYS Energy Code.

1.7 COORDINATION WITH OTHER TRADES

- A. Check Division 23 drawings with all others.
- B. Anticipate and avoid interferences with other trades.
- C. Take particular care to coordinate all piping, ductwork, plumbing and major electrical components above ceiling, to prevent conflict. Remove and relocate work as may be made necessary by such conflict, at no extra cost to the Owner. The use of coordination drawings is recommended but may not be required (refer to Division 1 for additional requirements). Lack of coordination drawings assumes contractor has verified and coordinated all work associated with installation.
- D. Obtain decision for approval from project Engineer for proposed group installation before proceeding, and for clearance in structure and finish of the building.
- E. Verify with drawings all ductwork and equipment layout in concealed areas.
- F. Running pipe and ductwork over electrical equipment and in elevator machine rooms is prohibited.
- G. The Contractor to coordinate with, receive and install, Owner furnished equipment where indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Make provisions for delivery and safe storage of all materials. Check and properly receipt material to be "furnished by others" to contractor, and assume full responsibility for all materials while in storage with full visible identification and information.

1.9 PROJECT CONDITIONS

- A. Existing Conditions: Field verify existing conditions that will determine exact locations, distances, levels, dimensions, elevations, etc. Review all drawings of other trades and report any conflicts to the Architect/Engineer which will affect

the project cost. Lack of field verification does not constitute a basis for additional monies during construction. Contractor assumes full responsibility for completeness of installation including coordination of work with other trades.

- B. The existing facility will be occupied and functioning during the entire duration of construction. Care shall be taken when working in or around occupied spaces. There will be no interruption in HVAC systems or utilities without written approval from the Owner.

1.10 SUBMITTALS

- A. Shop Drawings and Product Data: Submit shop drawings, wiring diagrams and/or equipment list for the following equipment and material.
1. Submit a list of the following sub-contractors
 - a. Sheet Metal
 - b. Piping
 - c. Insulation
 - d. Temperature Controls
 - e. Balancing - air and water procedures
- B. Required Shop Drawings

SECTION	MATERIAL ITEM
230506	PENETRATION FIRESTOPPING HVAC
230512	MOTOR CONTROLS
230523	VALVES
230529	PIPE HANGERS AND SUPPORTS
230553	PIPE AND VALVE IDENTIFICATION
230554	DUCT AND EQUIPMENT IDENTIFICATION
230593	CLEANING AND TESTING
230594	BALANCING OF SYSTEMS
230719	PIPING AND EQUIPMENT INSULATION
230713	DUCT INSULATION
230923	DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
230200	HVAC PIPING
232006	HYDRONIC SPECIALTIES
232201	STEAM SPECIALTIES
232202	STEAM TRAPS
233113	METAL DUCTWORK
233300	DUCTWORK ACCESSORIES
233713	DIFFUSERS, REGISTER, AND GRILLES

233723	ROOF MOUNTED AIR INLETS AND OUTLETS
233730	LOUVERS
235413	ELECTRIC CABINET HEATERS
236000	REFRIGERATION
237200	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT
238127	DUCTLESS SPLIT AIR CONDITIONING SYSTEM
238129	VARIABLE REFRIGERANT FLOW HVAC SYSTEM
238237	FINNED TUBE RADIATION
238239	UNIT HEATERS
238333	ELECTRIC TIN RADIATION

1.11 MISCELLANEOUS SUPPORT

- A. Mechanical Contractor is responsible for providing all miscellaneous support components necessary for properly supporting equipment provided by Mechanical Contractor including hangers, rods, anchors, steel, etc.

1.12 REQUIREMENTS BEFORE FINAL PAYMENT

- A. Lubricating Instruction
 - 1. Hang framed lubrication chart in Mechanical Room or adjacent to equipment installed by the Contractor.
 - 2. List name of equipment, recommended lubrication, and times required.
 - 3. Certify all equipment has been properly lubricated prior to turnover to Owner.
- B. Identification
 - 1. Tag all starters, etc., per Section 230553, "Pipe and Valve Identification" and Section 230554, "Duct and Equipment Identification."
 - 2. Hang typewritten list in equipment rooms where directed.
- C. Certification
 - 1. Submit to Engineer/Architect certificates of approval from electrical inspector or authority having jurisdiction over codes pertaining to work in this Division.
 - 2. Submit to Engineer/Architect certificate stating any refrigerant on the project has been handled and disposed of in accordance with EPA regulations.
- D. Instructional Period: Instruct Owner's representatives in complete operation of all components, to the satisfaction of the Owner and receive signed statement from Owner's representative certifying knowledge and understanding of all equipment and systems.
- E. Guarantees: Provide all guarantees as required by the Contract Documents with

a minimum of one year from the date of Substantial Completion on all labor and materials.

F. Start-up Report

1. Provide start-up report for each piece of mechanical equipment including date, electrical characteristics, temperature and pressure readings, etc.
2. This is intended for all items not specifically included in the Balancing Report.

G. Punch List signoffs

1. Punch lists and/or Observation Reports developed by the architect or engineer listing deficiencies shall be reviewed by the Contractor.
2. Items requiring corrective measures shall be completed and signed off as such by the contractor.
3. After all items have been corrected and initialed, the report shall be returned to the architect or engineer.

H. Operational Booklets (Maintenance Manuals)

1. Provide the Owner with two Operation Booklets which contain the following:
 - a. Acceptable shop drawings and submittals
 - b. Wiring diagrams
 - c. Installation & Maintenance Instructions
 - d. List of suppliers for all equipment provided including name, address and telephone numbers.
 - e. Test data
 - f. Operational instructions
 - g. Lubrication instructions
 - h. Start-up report
 - i. Balancing report (Air and Water)
 - j. As-built drawings

END OF SECTION 230500

SECTION 230505 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. Provide cutting and patching work required by work of this (sub) contract.
- B. Do not cut and patch in a manner that would result in a failure of the work to perform as intended, decreased structural integrity, decreased integrity of fire proofing, decreased energy performance, increased maintenance, decreased operational life or decreased safety. Specific attention shall be paid to the 2015 International Building Code as adopted by New York State, including Chapter 23 with regard to boring and notching of wood structural members.
- A. Requirements in this Section apply to mechanical, plumbing and electrical installations. Refer to Divisions 23 and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations. Requirements of this section shall be coordinated with requirements of Division 1 sections. In the event of conflict, the more stringent requirements shall be used.

1.3 DEFINITIONS

- A. Cutting: Removal of previously installed construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as

intended or that results in increased maintenance or decreased operational life or safety. This is to include but not be limited to the following:

1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire-protection systems.
 4. Control systems.
 5. Communication systems.
 6. Conveying systems.
 7. Electrical wiring systems.
 8. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain-wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise and vibration control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched-veneer woodwork.
 - e. Preformed metal panels.
 - f. Roofing.
 - g. Firestopping.
 - h. Window wall system.
 - i. Stucco and ornamental plaster.
 - j. Terrazzo.
 - k. Finished wood flooring.

- l. Fluid-applied flooring.
 - m. Aggregate wall coating.
 - n. Wall covering.
 - o. HVAC enclosures, cabinets, or covers.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED PENETRATIONS

- A. Refer to Divisions 3 through 20.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
 - 2. Fit work airtight to pipes, sleeves, ducts, conduits and other penetration through surfaces.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable

seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 230505

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SECTION 230506 - PENETRATION FIRESTOPPING HVAC

PART 1 GENERAL

1.1 REFERENCES

- A. UL 1479 Fire Tests of Through-Penetration Firestops.
- B. ASTM E 814 Method of Fire Tests of Through-Penetration Fire Stops.

1.2 DEFINITIONS

- A. UL Fire Resistance Directory: Product directory published yearly, with supplements, by Underwriters Laboratories Inc., containing listings and classifications in effect as of the published date for product categories covered by UL.
- B. Inchcape Directory of Listed Products: Product directory published yearly by Inchcape Testing Services containing listings which reflect certifications granted for materials, products, systems and equipment which have been tested by Inchcape Testing Services to recognized governing standards.
- C. Omega Point Laboratories Listings Directory: Product Directory published yearly by Omega Point Laboratories, Inc. containing listed building products, materials, and assemblies which have been tested by Omega Point Laboratories to recognized governing standards.
- D. Factory Mutual Approval Guide: Product directory published yearly, with supplements, by Factory Mutual Research Corp., containing listed building products, materials, and assemblies which have been tested by Factory Mutual Research Corp., to recognized governing standards.
- E. F Rating: Prohibits flame passage through the system and requires acceptable hose stream test performance.
- F. T Rating: Prohibits flame passage through the system and requires the maximum temperature rise on the unexposed surface of the wall or floor assembly, on the penetrating item and on the fill material not to exceed 325 degrees F above ambient, and requires acceptable hose stream test performance.
- G. Company Field Advisor: An employee of the Company which lists and markets the primary components of the system under their name who is certified in

writing by the Company to be technically qualified in design, installation, and servicing of the required products or an employee of an organization certified by the foregoing Company to be technically qualified in design, installation and servicing of the required products. Personnel involved solely in sales do not qualify.

1.3 DESIGN REQUIREMENTS

- A. Devices and materials shall meet the hourly fire resistance ratings required by the Project as determined by UL 1479, or ASTM E 814 and be listed and detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. Exception: Where no listed designs exist that meet the requirements of a specific project condition, submit details and manufacturer's written recommendations for a design meeting the requirements. Include evidence of engineering judgement and extrapolation from listed designs.

1.4 SUBMITTALS

- A. Submittals Package: Submit the following items specified below the same time as a package:
 - 1. Product Data.
 - 2. Samples.
 - 3. Quality Control Submittals.
 - 4. Firestop Schedule.
- B. Product Data: Catalog sheets, specifications and installation instructions for each firestop device and material.
 - 1. Indicate design number for each firestop proposed to be used which is detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 2. State the specific locations where each firestop system is proposed to be installed.
- C. Samples: One of each product if requested.
- D. Quality Control Submittals:
 - 1. Design Data: Show details and include engineering information and manufacturer's written recommendations required under Design Requirements Article for each proposed firestop if other than a design detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed

- Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
- a. State the specific locations where each firestop is proposed to be installed.
2. Installer's Qualifications Data:
 - a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
 - b. Names and addresses of 3 similar projects that each person has worked on during the past 5 years.
 3. Company Field Advisor Data:
 - a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor, and listing of services and each product specifically listed for this Project for which Company Field Advisor is given authorization by the Company to render advice.
- E. Firestop Schedule: Submit schedule itemizing the following:
1. Manufacturer's product reference numbers and/or drawing numbers.
 2. UL, Inchcape Testing Services, Factory Mutual Research Corp., or Omega Point Lab design number.
 3. Location of firestop material.
 4. Penetrating Item Description/Limits: Material, size, insulated or uninsulated, and combustibility.
 5. Maximum allowable annular space or maximum size opening.
 6. Wall type construction.
 7. Floor type construction.
 8. Hourly Fire resistance rating of wall or floor.
 9. F rating.
 10. T rating, if available.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: The persons installing the firestopping and their supervisor shall be personally experienced in firestop work and shall have been regularly employed by a company installing firestopping for a minimum of 3 years.
- B. Pre-Installation Conference: Before the firestop work is scheduled to commence, a conference will be called by the Director's Representative at the Site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by related trade Contractors (if any),

their qualified firestopping installers, and associated firestopping manufacturer's Company Field Advisors.

- C. Container/Package Labels: Include manufacturer's name and identifying product number, date of manufacturer, lot number, shelf life (if applicable), qualified testing and inspecting agency classification marking, curing time, and mixing instructions for multi-component materials.
- D. Company Field Advisor: Secure the services of a Company Field Advisor for the following:
 - 1. Render advice regarding suitability of firestopping materials and methods.
 - 2. Assist in completing firestop schedule.
 - 3. Attend pre-installation conference.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping materials to the Site in original, new unopened containers or packages bearing manufacturer's printed labels.
- B. Store and handle firestopping materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, etc.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Temperature: Do not install firestopping materials when ambient or substrate temperatures are outside limits permitted by manufacturer of firestopping materials.
 - 2. Humidity and Moisture: Do not install the Work of this Section under conditions that are detrimental to the application, curing, and performance of the materials.
 - 3. Ventilation: Provide sufficient ventilation wherever firestopping materials are installed in enclosed spaces. Follow manufacturer's recommendations.

1.8 SEQUENCING AND SCHEDULING

- A. Leave exposed those firestopping installations that are to be concealed behind other construction until the Director's Representative has examined each installation.

PART 2 PRODUCTS

2.1 FIRESTOPPING-GENERAL

- A. Through-Penetration Firestop Devices, Forming Materials, And Fill, Void or Cavity Materials: As listed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. For firestopping exposed to moisture, furnish products that do not deteriorate when exposed to this condition.
 - 2. For firestopping systems exposed to view, furnish products with flame-spread values of less than 25 and smoke developed values less than 50, as determined per ASTM E 84.
 - 3. For penetrations for piping services below ambient temperature, furnish moisture-resistant through-penetration firestop systems.
 - 4. For penetrations involving insulated piping, furnish through-penetration firestop systems not requiring removal of insulation.
- B. Accessories: Components required to install fill materials as recommended by the firestopping manufacturer for particular approved fire rated system.
- C. Identification Labels:
 - 1. Furnished by fire stopping manufacturer of suitable material for permanent field identification of through-penetration firestops.
 - 2. Identify the following:
 - a. "WARNING - FIRESTOP MATERIAL".
 - b. Company Name.
 - c. Product Catalog number.
 - d. F rating.
 - e. T rating, if available.
 - 3. Field fabricated labels are not acceptable.
- D. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing through-penetrations of floors, walls, partitions, ceilings and roofs in the Work areas.
- B. Where firestopping is missing or not intact, submit a written report to the Director's Representative describing the existing conditions.

3.2 PREPARATION

- A. Clean out openings immediately before installation of through-penetration firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove foreign materials from surfaces of openings, and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Protection:
 - 1. Protect surfaces adjacent to through-penetration firestops with non-staining removable masking tape or other suitable covering to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or that would be caused by cleaning methods used to remove smears from firestopping materials.
- C. Substrate Priming:
 - 1. Prime substrates in accordance with the firestopping manufacturer's printed installation instructions using recommended products and methods.
 - 2. Do not allow primer to spill or migrate onto adjoining exposed surfaces.

3.3 INSTALLATION OF THROUGH PENETRATION FIRESTOPS

- A. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, and limit temperature rise of the unexposed surface as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
 - 1. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form through-penetration firestop in accordance with approved printed details and installation

- instructions from the company producing the forming materials and fill, void or cavity material.
2. If the construction type(s) of the building cannot be determined, provide firestopping with fire resistance ratings as specified in the Building Code of New York State, Tables 720.1(1), 720.1(2), 720.1(3), and 302.3.2. Insulated pipes - select a system where the pipe insulation is permitted to pass through the construction. Insulation shall conform the requirements of the firestop system UL listing.
 - 3 Insulated ducts - insulation shall not extend through construction required to have a fire resistive rating.
 - 4 Pipes, tubing, conduits, cables and other building services - provide an appropriate UL listed firestop system.
 - 5 Ducts without a fire, or combination smoke/fire damper that penetrate a 1-hour rated wall - fill the annular space between the duct and the rated construction (both sides of the rated construction) with a non-hardening, intumescent, UL listed firestop product; and in the absence of manufacturer's firestop system installation instructions or Engineer's recommendation, attach 1½" angles around the perimeter of all ducts (both sides of the rated construction).
 - 6 Ducts with a fire, or combination smoke/fire damper - caulk against the rated construction at the perimeter of the damper sleeve angle iron frame (both sides of the rated construction) with a non-hardening, intumescent, UL listed firestop product. Do not fill the annular space around the damper sleeve.
- B. Provide through-penetration firestop systems with F ratings which shall equal or exceed the fire resistance rating of the penetrated building construction.
- C. Provide through-penetration firestop systems with T ratings, in addition to F ratings, at floors where the following conditions exist:
1. Where firestop systems protect penetrations located outside the wall cavities.
 2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
 3. Through-penetration firestop systems protecting floor penetrations require a T-rating of at least 1 hour, but not less than the required floor fire-resistance rating.
- D. Firestop through-penetrations of floors, walls, partitions, ceilings, and roofs.
- E. Firestop through-penetrations associated with the new Work.

- F. Permanently affix label at each firestop. Use adhesive compatible with surface construction at firestop location.

3.4 CLEANING

- A. Clean off excess fill materials and sealants adjacent to penetrations by methods and cleaning materials recommended by manufacturers of firestopping products and of products in which penetrations occur.
- B. Remove masking tape as soon as practical so as not to disturb the firestopping's bond with substrate.
- C. Protect firestopping during and after curing period from contact with contaminating substances, or damage resulting from adjacent Work.
- D. Cut out and remove damaged or deteriorated firestopping immediately, and install new materials as specified in firestop schedule.

END OF SECTION 230506

SECTION 230511 - WIRING OF MECHANICAL EQUIPMENT

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 RELATED WORK SPECIFIED ELSEWHERE

Division 26

1.3 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and instructions for each item specified.

1.4 SCOPE

- A. It is the requirement of this specification to have the Mechanical Contractor (MC) provide and install all CONTROL work for this project in accordance with Division 26 Sections. Control wiring may not be limited to low voltage wiring. Motor starters specified to be supplied by the Mechanical Contractor and not mounted in factory-built cabinets are to be handed over to the Electrical Contractor for mounting. The Electrical Contractor (EC) shall be responsible for all the POWER work to the mechanical equipment (not to include any power wiring inside factory supplied control cabinets). Combination motor starter disconnect switches are to be supplied by the Mechanical Contractor and installed by the Electrical Contractor. Disconnect switches not provided by the equipment manufacturers are to be supplied by the Mechanical Contractor and installed by the Electrical Contractor.
- B. The CONTROL WORK specifically includes all relays, switches, control valve actuators, damper actuators, wiring and other incidental devices for complete control and interlocking of the mechanical equipment.
- C. The POWER WORK specifically includes all conduit, wire, disconnects and other incidental devices for complete power feeds to mechanical equipment.
- D. Sizes of the motor circuit breakers and fuses shown on the drawings or in the specifications are based on criteria available at the time of design and are for

bidding purposes only.

- E. The Mechanical (Sub)Contractor (HC) and the Electrical (Sub)Contractor (EC) shall coordinate these sizes with the motors actually to be installed for correct motor short circuit and overload protection to insure that the electrical equipment is sufficient for the starting current of the motor and to insure compliance with all prevailing electrical codes.
- F. The EC shall size motor circuit breakers and fuses as directed by HC coordination. The HC shall bear all costs for electric changes caused by equipment substitutions.
- G. The Mechanical (Sub)Contractor (HC) shall be responsible for providing power circuiting (including wiring, conduit, breakers and accessories) for control panels and devices, unless indicated otherwise.
- H. All control wiring shall be installed in conduit or be neatly bundled and attached securely to the building structure. Wiring above 50 volt must be run in conduit. All NEC Class 2 (current-limited) wiring not installed in conduit shall be plenum rated and UL listed for the intended application.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Refer to Division 26 Specifications for product data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all electrical work in accordance with Division 26 Sections and the latest National Electrical Code.

END OF SECTION 230511

SECTION 230512 – MOTOR CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 and Division 15 Specification Sections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Variable Frequency Motor Controls: Section 230514

1.3 SCOPE OF WORK

- A. Mechanical (Sub)Contractor (MC) shall furnish all motor controls, disconnect switches and starters as required by this contract.
- B. MC shall be responsible for coordination of motor(s) with motor short circuit and overload protection device(s).
 - 1. For motors and devices within this contract.
 - 2. For motors within this contract and devices furnished by others (i.e., circuit breakers and/or fuses in panels furnished by the Electrical (Sub)Contractor (EC).
 - 3. For compliance of the devices with the N.E.C.
 - 4. To ensure device(s) is sufficient for the starting current of the motor(s).
 - 5. All costs resulting from this coordination shall be borne by the MC and EC, as regards their own work.
 - a. In the event of substitutions by the MC, all costs for revising attendant work by other trades shall be borne exclusively by the MC.

1.4 ACCEPTABLE STANDARDS

Cutler-Hammer
General Electric
Square D
Siemens

- 1. The starter manufacturer shall coordinate the starter with the motor actually to be installed.

2. Furnish enclosure type required for specific application and location.
3. UL listed and labeled.
4. Select motor overload protection based on actual motor nameplate data.

1.5 RELATED WORK SPECIFIED ELSEWHERE

Wiring of Mechanical Equipment: 230512

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog sheets and specifications for all items.
- B. All starters and disconnects required by this contract, whether for field installation or provided affixed to mechanical equipment (IE: Pumps, AHU's, RTU's, ETC) shall be of the same manufacturer. And shall comply with this specification.

PART 2 - PRODUCTS

2.1 MOTOR STARTERS

- A. Starter Type "A": Starter type "A" shall be a manual single phase starter for fractional (1/2 hp and less) motors
 1. NEMA 1 enclosure (NEMA 4X waterproof for outside use), 600 VAC rating.
 2. Red run pilot Light.
 3. Lockable handle guard.
 4. Thermal overload protection.
 5. Flush mounting with stainless steel faceplate in finished spaces.
 6. Where exposed in occupied spaces provide removable key type operator. Provide 4 sets of extra keys
 7. Provide two-pole starter. Purpose is to allow control power to be disconnected.
 8. Auxiliary N.O./N.C. contacts as required for control sequence.
- B. Starter Type "B": Starter type "B" shall be a Combination Automatic Starter/Disconnect, full voltage, non-reversing, NEMA Size 0 (minimum) used for 3/4 hp to 30 hp three phase motors.
 1. NEMA 1 enclosure (NEMA 4X waterproof for outside use), 600 VAC rating.
 2. Motor Circuit Protector shall be NEMA AB1 circuit breaker with instantaneous magnetic trip in each pole. Coordinated field adjustable short circuit trip settings with the motor lock rotor nameplate amperage.

3. Hand-Off-Automatic selector switch.
4. Red run pilot light.
5. External operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions. Doors mechanically interlocked to prevent opening unless the breaker within the enclosure is open. If a separate control circuit is indicated, furnish disconnect/circuit breaker with auxiliary contacts.
6. Thermal overload relay for each phase with external manual reset.
7. Provide one N.O. holding contact, and additional N.O./N.C. auxiliary contacts as required for control sequence.
8. For motors operating over 120 Volts phase to phase, incorporate a separate, heavy duty, control transformer with 120 Volt secondary, two primary fuses, one secondary fuse, and grounded secondary winding. Size with adequate capacity to operate connected pilot, indicating and control devices, including devices required by control sequence.
9. Phase failure and undervoltage protection with relays set for 80% voltage drop

2.2 DISCONNECT SWITCHES

- A. Non-fused disconnect switch for manual single phase fractional (1/2 hp and less) motors.
 1. Toggle type in a NEMA 1 enclosure (NEMA 4X waterproof for outside use), 600 VAC rating.
 2. Lockable handle guard.
- B. Fused disconnect switch for single or multi-phase motors.
 1. Blade type with pivot arm operating mechanism with fuses in a NEMA 1 enclosure (NEMA 4X waterproof for outside use), 600 VAC rating.
 2. Lockable handle guard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mechanical (Sub)Contractor shall furnish to the Electrical (Sub)Contractor all Mechanical equipment motor starters and disconnect switches not factory mounted. Electrical Contractor to mount and wire. Manual starters used to disconnect power to controllers shall be installed within sight of controller, per NEC.

- B. Use fused disconnect switches when required by the Mechanical equipment manufacturer and/or where indicated. Furnish fuse sizes as required by the Plumbing equipment manufacturer. Unless indicated otherwise, fuses shall be dual-element with 100,000 Ampere interrupting rating.

END OF SECTION 230512

SECTION 230523 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

HVAC Piping: Section 232000
Pipe and Valve Identification: Section 230553
Direct Digital Control for HVAC: Section 230923
Cleaning and Testing: Section 230593

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Valve Schedule: Valve schedule listing type of valve, manufacturer's model number and size for each service application.
- D. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Valves and pressure relief devices shall conform to the specifications, regulations and requirements of all Agencies (Federal, State and Local), Codes, Local Gas and Power Companies and Associations having jurisdiction governing construction, sizing, application and location of same.
- B. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.

- C. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- D. MSS Compliance: Comply with the various MSS Standard Practice Documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set globe and gate valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure to functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use hand wheels and stems as rigging points.

PART 2 - PRODUCTS

2.1 VALVES - GENERAL

- A. Valve Standardization: Valves supplied for each specific valve type shall be the product of one manufacturer. Valves from one or more manufacturers may be used.
- B. Valves shall be first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating. Valve parts of same manufacturer, size and type shall be interchangeable. All manually operated gate, globe and angle valves shall be of rising stem type, unless otherwise specified. All valves, which use packing, shall be capable of being packed when wide open and under full working pressure. Size valves the same size as the piping in which they are installed, unless specified otherwise.

- C. Furnish valves with chain operators when installed more than 8'-0" above grade or finished floor.

2.2 BALL VALVES

Conbraco Industries, Inc.; Apollo Division.
NIBCO Inc.
Stockham Valves & Fittings, Inc.
Watts Regulator Company.

- A. Type BV: 300 psig OWG, cold, non-shock and a minimum working water pressure of 200 psig at 250 degrees F., with screwed or soldered ends, as required by the particular application. Furnish two piece bronze body valve with full port bronze ball, balancing stop, "Teflon" seats, "Teflon" or "Viton" stuffing box washers and gland seals, blow-out proof brass stem and corrosion resistant steel manual operating handle with a cool gripping cover. Provide extended stem valve handles on all valves.

2.3 GATE VALVES

Hammond Valve Corporation.
Milwaukee Valve Company, Inc.
NIBCO Inc.
Stockham Valve & Fittings, Inc.

- A. Type A: MSS SP-80; Class 125, 200-psig OWG, cold working pressure (CWP); ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, Teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.
- B. Type B: MSS SP-80; Class 150, 300-psig OWG, cold working pressure (CWP); ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded end connections; and with aluminum or malleable-iron handwheel.
- C. Type C: MSS SP-70, Class 125, 200-psig OWG (150 psig OWG for 14" and larger), cold working pressure (CWP); ASTM A 126 class-B cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke IBBM OS & Y, teflon-impregnated packing with 2-piece packing gland assembly, flanged and screwed end connections; and with cast-iron handwheel.

2.4 CHECK VALVES

Hammond Valve Corporation.
Milwaukee Valve Company, Inc.
NIBCO Inc.
Stockham Valves & Fittings, Inc

- A. Type A: 125 psig WSP, 200 psig OWG, 350 psig shell hydrostatic tests, horizontal swing, bronze body, brass or bronze trim, regrindable and renewable disc. Disc shall be rubber faced for cold water service and TFE for steam and steam condensate. Screwed ends.
- B. Type B: 125 psig WSP, 200 psig OWG, 300 psig shell hydrostatic tests, horizontal swing, bronze body, brass or bronze trim, regrindable and renewable disc with solder ends. Disc shall be rubber faced for cold water service.
- C. Type C: IBBM, 125 psig WSP, 200 psig OWG, 350 psig shell hydrostatic tests, bolted cover of iron or brass, regrindable and renewable seat ring and disc. Disc may be cast iron with bronze face on 4" and larger.

2.5 GLOBE AND ANGLE VALVES

Hammond Valve Corporation.
Milwaukee Valve Company, Inc.
NIBCO Inc.
Stockham Valves & Fittings, Inc

- A. Type A: 150 psig WSP, 300 psig OWG, 400 psig hydrostatic tests, bronze body, 500 Brinnel hardness stainless steel plug and 500 Brinnel hardness stainless steel replaceable seat ring, threaded ends.
- B. Type B: IBBM, OS&Y, 125 psig WPS, 200 OWG psig non-shock, 200 psig seat and 300 psig shell hydrostatic tests for valves up to 12". Screwed or flanged ends depending on size.
- C. Type C: 200 psig OWG, 300 psig hydrostatic tests, bronze body, solder ends, non-rising or rising stem.

2.6 LUBRICATED PLUG VALVES

Hammond Valve Corporation.
Milwaukee Valve Company, Inc.
NIBCO Inc.
Stockham Valve & Fittings, Inc.

- A. Type AB: 125 psig OWG with screwed ends. Valve shall have cast iron body, brass plug with a phosphor bronze spring washer and a lubrication system. A valve wrench shall be furnished for each valve type or size.

2.7 BUTTERFLY VALVES

Hammond Valve Corporation.
Milwaukee Valve Company, Inc.
NIBCO Inc.
Keystone

- A. Type BF: Iron body, flangeless wafer lugged type, (lug for each bolt hole) drilled and tapped for cap screws, build for 150 psig OWG at 180 degrees F., with replaceable reinforced resilient EPT (EPDM) seats. Valve bodies shall have raised necks of height as required to accommodate a minimum of 2" insulation for valves installed in piping systems specified to be insulated. Discs shall be bronze and stems shall be carbon steel or stainless steel. Valves shall be provided with manual actuating handles. Manual actuator handles shall be provided with an external indication of disc position and a suitable means of locking actuator in any fixed position.

2.8 BALANCING VALVES

Taco Inc.
Armstrong Pumps, Inc.
Bell & Gossett Div., ITT Fluid Technology Corp.

- A. Calibrated Balancing Valve shall be of heavy brass, Ametal copper-alloy, or ductile iron construction, with visible graduated dial indicator built for a working water pressure of 200 psig at 250 degrees F., of straightway pattern. Valves shall have ports for reading pressure drop and charts calibrated to indicate corresponding flows. Adjustment shall be made by means of wheel handle with full turn opening.

2.9 DRAIN VALVES

Conbraco Industries, Inc.; Apollo Division mdl 78-200
NIBCO Inc. T-585-70-HC
Watts Regulator Company B-6000-CC

- A. Ball Drain Valves: MSS SP-110, Class 150, 600-psi (4140-kPa) CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port valves; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
 - 1. Operator: Vinyl-covered steel lever handle.

2. Stem Extension: For valves installed in insulated piping.
3. Hose thread connection and brass cap with chain.

2.10 NEEDLE STOP VALVES

Marsh Instrument Co.
H.O. Trerice Co.
Weksler Instruments Co.

- A. For Temperatures to 300 degrees F.: All brass or forged carbon steel construction, union bonnet, screwed ends, built for 1000 psi at 300 degrees F.

2.11 GAGE COCKS

Marsh Instrument Company
Mueller Instruments Co.
H.O. Trerice Co.
Weksler Instruments Co.

- A. Gage Cocks: All brass construction, "T" or lever handles, screwed ends, built for 300 psig hydraulic pressure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until satisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions, flanges or grooved joint couplings at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Furnish valves with chain operators when installed more than 8'-0" above grade or finished floor. Extend chains to 60" above grade or finished floor.
- H. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.

3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joints, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.7 VALVE APPLICATION SCHEDULE

- A. Written continuity for specifying valves, using abbreviations and types, as employed under this Article, is as follows: Service of piping, symbol of service, pressure rating psig, size of valves, pipe end connection or valve end type, type of valve (gate or butterfly, globe or angle, check) in the aforementioned order unless otherwise specified.
- B. General Application: Gate, ball, and butterfly valves for shutoff duty. Globe, ball and butterfly valves for throttling duty.

C. Schedule of valve applications for the different services is as follows:

1. Hot Water - 125 psig and Less:
 - a. 2" and Less: BV ball valves, A or B checks. Screwed or solder ends.
 - b. 2-1/2" and Up: BF butterfly, C checks. Flanged.
2. Steam - 15 psig and Less:
 - a. 2" and Less: B gates, A globe or angles and A checks. Screwed or flanged end.
 - b. 2-1/2" and Up: C gates, and C checks. Flanged end.
3. Condensate Returns - 125 psig and Less:
 - a. 4" and Less: B or C gates, and A checks. Screwed or flanged end.
 - b. 5" and Up: C gates and C checks. Flanged end.

3.8 CALIBRATED BALANCING VALVE APPLICATION SCHEDULE

A. Valves at full open shall have a pressure drop of approximately 5 ft. wg

B. Schedule of valve sizes and flows to be used is as follows:

Size (in.)	Nominal Flow (gpm)	Max* Flow (gpm)
1/2	0.5 - 2.8	4.5
3/4	2.8 - 6	10
1	6 - 10	15
1-1/4	10 - 15	25
1-1/2	15 - 20	34
2	20 - 36	60
2-1/2	36 - 100	160
3	100 - 130	220
4	130 - 200	320
5	200 - 320	520
6	320 - 450	700

*Maximum flow is calculated for the valve fully open and ΔP approximately 5 ft. wg (speed of water max 8.5 ft/sec)

C. Valve chart is based on Tour and Anderson, Model STAD/STAT and STAF.STAG. Verify valve size with manufacturer for specific application.

END OF SECTION 230523

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SECTION 230529 - PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Piping and Equipment Insulation: Section 230719

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Details of trapeze hangers and upper hanger attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.
 - 2. Details of pipe anchors.
- B. Product Data: Catalog sheets, specifications and installation instructions for each item specified except fasteners.

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Companion high density filler pieces for installation over the top 180 degree surface of pipe or tubing, at points of support where a combination clevis hanger, insulation shield and high density insulating saddle are installed

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
 - 1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover

the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAGE	SADDLE LENGTH (Inches)	VAPOR BARRIER JACKET LENGTH (Inches)
UP to 2-1/2	4	16	6	10
3 to 6	4	14	6	10
8 to 14	10	12	12	16
16 and up	10	10	12	16

- B. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAGE
Up to 2-1/2	8	18
3 to 8	10	16
10 to 14	12	12
16 and up	18	10

- C. Pipe covering Protection Saddles: 3/16 inch thick steel, of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

PIPE SIZE (Inches)	SADDLE LENGTH (Inches)	SADDLE GAGE
8" and up	12"	7 (3/16")

- D. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and

nut. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping 10 inches and larger.

1. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of 2 inches in size.
- E. Adjustable Floor Rests and Base Flanges: Steel
 - F. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.
 - G. Riser Clamps: Malleable iron or steel.
 - H. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, 2-1/2 to 20 inches, from single rod if horizontal movement caused by expansion and contraction might occur.
 - I. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, 2 to 30 inches, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction
 - J. Restraints, Anchors, and Supports for Grooved End Piping Systems: As recommended by the grooved end fitting manufacturer.
 - K. Foam Insulated Pipe Hanger: Single-piece thermally insulated pipe hanger with self-adhesive closure. CFC-free PET load-bearing segments embedded in closed cell insulation with outer shell of 30-mil thick painted aluminum.

2.2 FASTENERS

- A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN1405, HN-1614, FS-1411 Series.
- B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS-3822.
- C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips Series S-14.
- D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

- E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS-38 Series.
- F. Continuous Slotted Type Concrete Insert, Galvanized:
 - 1. Load Rating 800 lbs/ft: Kindorf's D-986.
 - 2. Load Rating 1500 lbs/ft: Kindorf's D-980.
 - 3. Load Rating 3000 lbs/ft: Hohmann & Barnard's Inc. Type CS-H.
 - 4. Load Rating 4500 lbs/ft: Hohmann & Barnard's Inc. Type CS-HD.
- G. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4 inch dia machine bolts.
- H. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, designed to accept 3/4 inch dia bolts having special wedge shaped heads.
- I. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.3 SHOP PAINTING AND PLATING

- A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper pipe or copper tubing.
- B. Hanger supports for chromium plated pipe shall be chromium plated brass.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

- A. Place inserts into construction form work expeditiously, so as not to delay the Work.

3.2 INSTALLATION

- A. Do not hang or support one pipe from another or from ductwork.
- B. Support all insulated horizontal piping by means of hangers or supports with insulation shields installed outside of the insulation.

- C. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.

1. For Steel, Alloy Steel, and Fibrous glass Reinforced Plastic Pipe (FRP):

Pipe Size (Inches)	Maximum Spacing (Feet)
1 and under	8
1-1/4 and 1-1/2	9
2	10
2-1/2 and over	12

2. For Copper Pipe and Copper Tubing:

PIPE OR TUBING SIZE (Inches)	MAXIMUM SPACING (Feet)
3/4 and under	5
1-1/4	6
1-1/2 and 2	8
2-1/2	9
3 and over	10

3. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
4. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
5. For Branch Piping Runs and Runouts over 5 Feet in Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
6. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the

material being used.

D. Size hanger rods in accordance with the following:

PIPE OR TUBING SIZE (Inches)	SINGLE ROD HANGER SIZE (Inches)		DOUBLE ROD HANGER SIZE (Inches)	
	Pipe	Tubing	Pipe	Tubing
1/2 to 2	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10 and 12	7/8	5/8	3/4	5/8

- Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each rod, two at upper hanger attachment and two at hanger.

E. Vertical Piping:

- Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 10 feet on copper pipe and 15 feet on steel pipe, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.
- Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.
- Install intermediate supports between riser clamps on maximum 6 foot centers, for copper tubing risers 1-1/4" in size and smaller, installed in finished rooms or spaces other than mechanical equipment machine or steam service rooms, or penthouse mechanical equipment rooms.
- Support hubless cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and by malleable iron or steel riser

clamps with the extension arms at each floor level, with the distance between clamps or intermediate supports not to exceed 12 feet. Support risers in vertical shafts equivalent to the aforementioned.

- F. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.

3.3 UPPER HANGER ATTACHMENTS

A. General:

1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. "C" clamp type of upper hanger attachments with restraining straps may be used as upper hanger attachments for the support of piping up to a maximum of 3 inches in size and a temperature from 50 degrees F to 200 degrees F.

- B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.

1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. "C" clamp type of upper hanger attachments with restraining straps may be used as upper hanger attachments for the support of piping up to a maximum of 3 inches in size and a temperature from 50 degrees F to 200 degrees F.

- C. Attachment to Concrete Filled Steel Decks (Total thickness, 2-1/2 inches or more): Where necessary, attach hangers to the deck with welding studs (except at roof decks), thru-bolts with fish plates or tee hangers. Do not support a load, in excess of 250 lbs from any single welded stud.

- D. Attachment to Cast-In-Place Concrete: Secure to overhead construction by means of cast-in-place concrete inserts.

- E. Attachment to Existing Cast-In-Place Concrete:

1. For piping up to a maximum of 4 inches in size, secure hangers to overhead construction with self-drilling type expansion shields and machine bolts.
 2. Secure hangers to wall or floor construction with single unit expansion shields or self-drilling type expansion shields and machine bolts.
- F. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Secure attachments to structural steel wherever possible. When fill is applied over decks, thru-bolts and fish plates may be used to support piping up to a maximum of 4 inches in size; mechanically expanded rod hangers or toggle bolts may be installed in cells for the support of piping up to a maximum of 2-1/2 inches in size.
- G. Attachment to Hollow Block or Tile Filled Concrete Decks: Secure hangers to structural steel wherever possible. Inserts may also be used by omitting a block and pouring a solid concrete block, with a cast-in-place insert where required.
- H. Attachment to Waffle Type Concrete Decks: Provide cast-in-place inserts where required. When fill is applied over deck, thru-bolts and fish plates may be used.
- I. Attachment to Precast Concrete Tee Construction:
1. Secure hangers to tees by any of the following methods:
 - a. Tee hanger inserts between adjacent flanges.
 - b. Thru-bolts and fish plates, except at roof deck without concrete fill.
 - c. Dual unit expansion shields in webs of tees. Install shields as high as possible in the webs.
 2. Exercise extreme care in the field drilling of holes to avoid damage to reinforcing.
 3. Do not use powder driven fasteners.
- J. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.
1. Secure side beam connectors to wood members with two No. 18 x 1-1/2 inch long wood screws, or two No. 16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
 2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts or lag screws, in the sides of a timber or a joist, at the mid-point or above, not less than 2-

1/2 inches from the lower edge when supporting branch lines and not less than 3 inches from the lower edge when supporting mains. Install heavy gage steel washers under all nuts.

3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

PIPE SIZE (Inches)	LAG SCREW SIZE (Inches)	BOLT DIAMETER (Inches)
2 and under	3/8 diam x 1-3/4	3/8
2-1/2 and 3	1/2 diam x 2	1/2
4 and 5"	Use bolt	5/8

- a. Do not support piping larger than 3 inches with lag screws. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
- b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

LAG SCREW DIAMETER (Inches)	NOMINAL WIDTH OF BEAM FACE (Inches)
3/8	2
1/2	3

4. Do not secure hanger attachment to the diagonals or vertical members of the trusses.

3.4 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS AND SWAY BRACES

- A. Install pipe anchors, restraints and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner which will not affect the structural integrity of the building.

3.5 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

- A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or

tubing to be insulated for cold and hot service insulated piping. Direct hanger contact of pipe for hot or cold piping is not allowed. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.6 PIPE SUPPORT FOR SYSTEMS INSULATED WITH FLEXIBLE ELASTOMERIC FOAM

- A. Install a single-piece thermally insulated pipe hanger with self-adhesive closure at all points of support for piping or tubing to be insulated for cold and hot service insulated piping. Direct hanger or clamp contact of pipe for hot or cold piping is not allowed.

3.7 PIPE INSULATION SHIELDS

- A. Install a pipe insulation shield (unless provided with a combination clevis hanger as described above) at all points of support, for cold and hot service insulated piping. Direct hanger contact of pipe for hot or cold piping is not allowed. Center shields on all hangers and supports, and install in such a manner so as not to cut, puncture or compress insulation.

3.8 PIPE COVERING PROTECTION SADDLES

- A. Install pipe covering protection saddles at all points of support, for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

END OF SECTION 230140

SECTION 230553 - PIPE AND VALVE IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Duct and Equipment Identification: Section 230554

1.3 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions for each item specified.

1.4 REFERENCES

ANSI A13.1 - Scheme for Identification of Piping Systems

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

W.H. Brady Co., Milwaukee, WI.
Emed Co., Buffalo, NY.
Panduit Corp., Tinley Park, IL.
Seton Nameplate Corp., New Haven, CT.
Bunting Inc., Pittsburgh, PA.

2.2 PIPE MARKERS AND ACCESSORIES

- A. Snap-on Marker: One piece wrap around type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.
- B. Strap-On Marker: Strip type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions,

factory applied grommets, and pair of stainless steel spring fasteners.

- C. Stick-On Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.
- D. Pipe Marker Legend and Color Field Sizes:

OD of Pipe or Insulation (Inches)	Letter Size (Inches)	Length of Color Field (Inches)
3/4 to 1-1/4 incl.	1/2	8
1-1/2 to 2 incl.	3/4	8
2-1/2 to 6 incl.	1-1/4	12
8 to 10 incl.	2-1/2	24
Over 10	3-1/2	32

- E. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.
 - 1. Plain Tape: Unprinted type; color to match pipe marker background.
 - 2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.
- F. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.

2.3 PIPE SERVICE IDENTIFICATION TAGS

- A. Type: No. 19 B & S gage brass, with 1/4 inch high pipe service abbreviated legend on one line, over 1/2 inch high pipe size legend in inches, both deep stamped and black filled; and 3/16 inch top hole for fastener.
- B. Size: 2 inch square tag.
- C. Fasteners: Brass "S" hook or brass jack chain of size as required for pipe to which tag is attached.

2.4 VALVE SERVICE IDENTIFICATION TAGS

- A. Type: No. 19 B & S gage brass, with 1/4 inch high valve service abbreviated

lettering on one line over 1/2 inch high valve service chart number, both deep stamped and black filled; and with 3/16 inch top hole for fastener.

- B. Sizes: HVAC Use: 1-1/2 inch dia round.
- C. Fasteners: Brass "S" hook or brass jack chain of size as required for valve stem or handle to which tag is attached.

2.5 VALVE SERVICE IDENTIFICATION CHART FRAMES

- A. Type: Satin finished extruded aluminum frame with rigid clear plastic glazing, size to fit 8-1/2 x 11 inches valve chart.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Complete testing, insulation and finish painting Work prior to completing the Work of this Section.
- B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.

3.2 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturers printed installation instructions, unless otherwise specified.
- B. Stick-On Pipe Markers:
 - 1. Install minimum of 2 markers at each specified location, 90 degrees apart on visible side of pipe.
 - 2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.
- C. Pipe Size Labels: Install labels adjacent to each pipe marker and upstream from flow arrow. Install a minimum of 2 pipe size labels at each specified locations, 90 degrees apart on visible side of pipe.
- D. Pipe Service Identifications Tags: Attach tags to piping being identified with "S" hooks or jack chains.

3.3 PIPING IDENTIFICATION SCHEDULE

- A. Piping Identification Types:
 - 1. Piping or Insulation under 3/4 inch od: Pipe identification tags.
 - 2. Piping or Insulation 3/4 inch to 5-7/8 inch od: Snap-on marker or stick-on marker.
 - 3. Piping or Insulation 6 inch od and Larger: Strap-on marker or stick-on marker.
- B. Identify all piping systems, installed within and exterior of the building, piping exposed to view, above all ceilings, bare and insulated, as to content, size of pipe and direction of flow, with the following exceptions:
 - 1. Piping in furred wall spaces, except in valve access panels where valves and piping shall be identified as specified for exposed piping systems.
 - 2. Piping exposed in finished spaces such as offices, classrooms, wards, toilet rooms, shower rooms and spaces as specified.
- C. Locate piping identification (within 24") at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs. Where two or more pipes run in a parallel, place the printed legend and other markers in the same relative location.

3.4 VALVE IDENTIFICATION SCHEDULE

- A. Valve Service Identification Tags:
 - 1. Tag service, balance, isolation and control valves installed under this project, with a brass tag fastened to the valve handle or stem, marked to indicate service and numbered in sequence for the following applications:
 - a. Valves in heating, ventilating, air conditioning and refrigeration systems.
- B. Valve Service Identification Charts:
 - 1. Provide 2 framed valve charts for each piping system specified to be provided with valve identification tags. Type charts on 8-1/2 x 11 inches heavy white bond paper, indicating valve number, service and location.
 - 2. Hang framed charts at locations as directed.

END OF SECTION 230553

SECTION 230554 - DUCT AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Pipe and Valve Identification: Section 230553

1.3 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions for each item specified

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver paint to the Site in original, new unopened containers, bearing manufacturers' printed labels.
- B. Store materials at the site where directed. Keep storage space clean and accessible to the Engineer at all times.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Do not execute the Work of this Section until all testing, insulation and finish painting Work have been completed.

3.2 EQUIPMENT IDENTIFICATION

- A. Identify mechanical equipment, bare or insulated, installed in the following spaces or rooms, by means of painted stenciled legends:
 - 1. Roof – Provide engraved aluminum nameplate
 - 2. At Grade – Provide engraved aluminum nameplate

B. Engraved Aluminum Nameplate:

1. Black surface, with white (letter color). Fabricate in sizes required for message. Provide two side holes for mechanical fastening.
2. Engraved with engraver's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 0.020 inch.
4. Fasteners: Self-tapping stainless steel screws or aluminum pop rivet

C. Samples of Equipment Identification:

1. Condensing Unit CU-1

3.3 ACCESS DOOR IDENTIFICATION

- A. Access doors adjacent to fire damper, smoke damper or smoke detector shall be identified with letters no less than 1/2" high in accordance with NYS IMC.

3.4 CLEANING

- A. Clean adjacent surfaces of paint spatters resulting from the Work of this Section.

END OF SECTION 230554

SECTION 230593 - CLEANING AND TESTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Balancing of Systems: Section 230594

1.3 SUBMITTALS

- A. Quality Control Submittals
 - 1. Test Reports (Field Tests):
 - a. Refrigeration Systems: Submit results of Refrigeration Systems Pressure - Dehydration Tests.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Perform factory testing of factory fabricated equipment in complete accordance with the agencies having jurisdiction.
 - 2. Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

1.5 PROJECT CONDITIONS

- A. Protection: During test Work, protect controls, gages and accessories which are not designed to withstand test pressures. Do not utilize permanently installed gages for field testing of systems.

1.6 SEQUENCING AND SCHEDULING

- A. Transmit written notification of proposed date and time of operational tests to the Owner's Representative at least 5 days in advance of such tests.
- B. Perform cleaning and testing Work in the presence of the Owner's Representative.
- C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work.
- D. Duct Systems: Clean new and existing duct system(s) before testing, adjusting, and balancing.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Test Equipment and Instruments: Type and kind as required for the particular system under test.
- B. Test Media (air, gas, refrigerant, vacuum, water): As specified for the particular piping or system under test.
- C. Cleaning Agent (chemical solution, steam, water): As specified for the particular piping, apparatus or system being cleaned.

PART 3 EXECUTION

3.1 PRELIMINARY WORK

- A. Thoroughly clean pipe and tubing prior to installation. During installation, prevent foreign matter from entering systems. Prevent if possible and remove

stoppages or obstructions from piping and systems.

- B. Connections or extension of existing piped systems: Prior to connecting to any existing system(s), the Mechanical Contractor shall take sample of fluid and provide test reports of the existing fluids chemical, residuals and or glycol concentration to the Engineer for acceptance. If the test results have not been provided prior to connection, the Mechanical Contractor shall be held responsible in bringing the entire hydronic system within acceptable specifications. The Mechanical Contractor shall top off the new or existing glycol feed tank, at project closeout.
- C. Thoroughly clean compressed air, control air, refrigerant pipe and similar systems prior to pressure or vacuum testing.

3.2 PRESSURE TESTS - PIPING

- A. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.
- B. Water Systems:
 - 1. Circulating water systems, including propylene glycol solution systems and cold water make-up piping connections to heating, ventilating, air conditioning and refrigeration systems, unless otherwise specified:
 - a. Before final connections are made perform hydrostatic test at 1-1/2 times the maximum working pressure, but not less than 125 psig, for 4 hours.
 - b. After final connections are made perform hydrostatic retest at a pressure equal to maximum operating system design pressure, but not less than 30 psig, for 4 hours.
- C. Steam, Condensate Return and Pump Discharge Piping: Before final connections are made perform hydrostatic test at 1-1/2 times maximum working pressure, but not less than 150 psig for one hour.

3.3 HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS - CLEANING AND OPERATIONAL TESTING

- A. Circulating Water Systems:
 - 1. Cleaning: Flush systems and apparatus, upon completion of pressure and miscellaneous tests. Completely open valves and flush each system with

clean water, prior to chemical cleaning. Repeatedly flush at short intervals until twice the system water capacity has been flushed through. Chemically clean systems immediately following flushing operations. Circulate a solution consisting of Citri-Clean in dilution rates as indicated by manufacturer. Completely fill system with cleaning solution; vent system and place in operation, with automatic controls operating and valves fully open. Allow system to reach design operating temperature or an operating temperature designated by the Owner's Representative. Circulate the solution through the system for a minimum of 4 consecutive hours; immediately drain system and flush with clean water until the pH at the farthest drain matches the clean water input. Keep strainers unplugged during cleaning operations. Remove and clean strainer screens prior to operational test. Refill system with clean water.

2. Operational Test: Run system in an automatic mode for a minimum of 120 consecutive hours. During this time, make final adjustments, including the setting of the balancing valves.

B. Steam Heating Systems:

1. Cleaning: Upon completion of pressure and miscellaneous tests, place the system in automatic operation, at a steam pressure as directed. Rid the system of dirt, sludge and foreign substances by means of a 4 hour steam blow down period, during which time waste the condensate. Periodically blow down strainers during cleaning operations and totally clean strainers and trap elements at end of blow down.
2. Operational Test: Run system in an automatic mode for a minimum of 120 consecutive hours, with final connections made to apparatus, equipment and accessories. Make final adjustments.

3.4 DUCT SYSTEM AND EQUIPMENT CLEANING

A. Duct Systems:

1. Use service openings for entry and inspection.
 - a. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Ductwork Accessories" for access panels and doors.
 - b. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - c. Remove and reinstall ceiling to gain access during the cleaning process.

2. Particulate Collection and Odor Control:
 - a. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - b. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- B. Clean the following components by removing surface contaminants and deposits:
 1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- C. Mechanical Cleaning Methodology:
 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to

manufacturer's written instructions after removal of surface deposits and debris.

3.5 REFRIGERATION SYSTEMS - TESTING, DEHYDRATION AND CHARGING

- A. Leak Test Procedure:
 - 1. Refrigerant Piping Systems:
 - a. Pressurize with dry nitrogen to 50 psig and test for leaks using a bubble type solution.
 - b. Release this partial test pressure and correct deficiencies.
 - c. Charge system with a trace of refrigerant to 15 psig, then add dry nitrogen until system test pressures are reached and retest for leaks with an electronic leak detector.
 - d. Release pressure, repair leaks and retest as necessary until no leaks occur.
 - e. Recover refrigerant used for leak testing.
 - 2. System Test Pressures:
 - a. Charge system with dry nitrogen and trace of refrigerant (HFC 134A, HFC 245, HFC 404, HFC 407C, HFC 410A or HFC 507) to 350 psig and retest for leaks with an electronic leak detector. The system must stay at 350 psig pressure for 24 hours to pass the system test pressure test.
 - b. Release pressure, repair leaks and retest as necessary until no leaks occur.
 - c. Recover refrigerant used for leak testing.
- B. Dehydration:
 - 1. Low and Ultra Low Temperature Refrigeration Systems (-30 degrees F to 32 degrees F):
 - a. Following pressure tests, dehydrate each system with a vacuum pump.
 - b. Draw and hold an initial vacuum of 800 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
 - c. Draw and hold a second vacuum of 500 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
 - d. Draw and hold a third vacuum of 250 microns for 8 to 12 hours with an allowable maximum rise of 50 microns. Break this third vacuum by adding liquid refrigerant specified for the equipment to the high side of the system (liquid line).
 - e. Verify vacuum obtained with an electronic vacuum gage.
 - 2. Medium Temperature Refrigeration Systems (33 degrees F to 55degrees F), and Air Conditioning Systems:

- a. Following pressure tests, dehydrate each system with a vacuum pump.
 - b. Draw and hold an initial vacuum of 500 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
 - c. Draw and hold a second vacuum of 500 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
 - d. Verify vacuum obtained with an electronic vacuum gage.
- C. Refrigerant Charging: Follow equipment manufacturer's printed charging directions unless otherwise specified.
 1. Introduce refrigerant of type and quantity required through a filter/drier installed in the temporary charging line.
 - a. Purge small amount of liquid out of the system side of the charging hose.
 - b. Prevent moisture and other contaminants from entering the system.
 2. Charge liquid refrigerant through a charging valve provided in the high pressure side of the system.
 - a. Small amounts of gaseous refrigerant may be charged through the compressor suction service valve port.
 3. No bubbles shall appear at the moisture-liquid indicator when the system is fully charged and operational. Do not overcharge.
 4. Record the weight in pounds of refrigerant charged into each system and submit this record to the Director's Representative.
- D. Compressor Oil Charge: Pump oil into the compressor after the last vacuum has been preformed. Follow all Manufactures Recommended for oil type and amount to be installed.
- E. Adjustments and Operational Testing:
 1. Adjustments: Place the system in operation with automatic controls functioning. Adjust controls and apparatus for proper operation. Test thermometers and gages for accuracy over the entire range. Remove and replace items found defective.
 - a. Check belts, fan blades, fittings, TXV bulbs, and electrical connections for tightness before start up.
 - b. Check TXV bulb for proper location should be between 8 and 10 o'clock or 2 & 4 o'clock.
 - c. Seal off all holes in the condition space as specified.
 - d. Provide a point to point control check of the system to ensure that the specified inputs and outputs are receiving the signal from the proper sensors or controlling the proper device.

- e. Set pressure controls and safety controls.
 - f. Close or de-energize all solenoids, and start up the system.
 - g. Check that all controls and safety switches are operating properly.
 - h. Adjust TXV for proper super heat back to the compressors.
 - i. Clean TXV strainers as many times as required.
 - j. After one week of run time, change the liquid cores if they are the replaceable type.
 - k. After one month of run time, replace the liquid cores and compressor suction socks. Replace the liquid cores as required. Clean the TXV's as required.
2. Operational Test:
- a. Place system in operation, with final connections to equipment and with automatic controls operating, and operate for a minimum of 120 consecutive hours.
 - b. Operational test shall prove to the satisfaction of the Director's Representative that the system can produce the cooling effect required by the drawings and the specifications.

3.6 INSTALLATION

- A. Connections or extension of existing glycol piping systems: Prior to connecting to the existing system(s), the Mechanical Contractor shall take sample of fluid and provide test reports of the existing fluids concentration of glycol and residuals to the Engineer for acceptance. If the test results have not been provided prior to connection, the Mechanical Contractor shall be held responsible in bringing the entire hydronic system within acceptable specifications. The Mechanical Contractor shall top off the new or existing glycol feed tank, at project closeout.

END OF SECTION 230593

SECTION 230594 - BALANCING OF SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Cleaning and Testing: Section 230593

1.3 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Testing, Adjustment and Balancing Reports: Submit final testing and balancing results on applicable report forms, as approved or furnished by the environmental systems balancing council or bureau, which is certifying the independent member agency performing the Work, required by this Section. Each final systems report form shall bear the signature of the person performing the Work and recording the data and the signature of the certified supervisor for the performing agency. Submit simultaneously with the final reports, a list of the instruments used with the last date of calibration for each instrument.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Provide the services of a certified independent agency for the testing, adjustment and balancing of all air distribution and hydronic distribution systems complete with all connected apparatus and equipment. The agency shall be certified by the Associated Air Balance Council Bureau - AABC, Washington, DC 20005, National Environmental Balancing Bureau - NEBB, Arlington, Va. 22209 or by pre-approval of the engineer.
 - 2. The Work shall be performed by skilled mechanical technicians under the direct supervision of certified personnel in the employ of the independent agency. The supervisor shall be personally certified by the national council or bureau, as approved by the Engineer.

1.5 SEQUENCING AND SCHEDULING

A. Scheduling:

1. Perform environmental systems testing and balancing after cleaning, miscellaneous testing, adjustment and operational testing Work has been completed.
2. Test and balance system during a period of time when outside temperature conditions will impose a significant load on the system; i.e., summer months for air conditioning system, winter months for heating system. Balance and adjust systems accordingly. Return to the site as required.
3. Send written notification to the Owner's Representative a minimum of five days prior to the performance of testing and balancing Work. Perform testing and balancing Work in the presence of the Owner's Representative.

1.6 ACCURACY

- A. Outlets and equipment shall be balanced to within 5% of design airflows. Portions of systems unable to be balanced to these criteria shall be brought to the attention of the Engineer.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. General Information: Test instruments are included in this specification for information only. Balancing of air and hydronic systems shall be performed by qualified personnel utilizing company owned test instruments, which will remain the property of the company. Use test instruments which are in first class operating condition, with individual calibration histories to guarantee their accuracy. Test instruments shall be of type and kind as required by the type of system installed. Trade names and manufacturer's names are mentioned in this section for descriptive purposes only; instruments of equivalent range and capabilities may be utilized.
- B. Air Balancing Instruments:
1. Manometers: Inclined with ranges of 0 to 1/4" and 0 to 1"; Combination inclined and vertical with a range of 0 to 5" and U tube type, 18".
 2. Portable "Magnehelic" Draft Gages: Ranges 0 to 1/2", 0 to 1" and 0 to 5".
 3. Anemometers: Deflecting vane type with a range of 100 to 3000 fpm, similar to Alnor Velometer Model 6000 BP and 4" diameter rotating vane

type.

4. Pitot Tubes: ASHRAE standard type, stainless steel, 5/16" diameter, lengths as required.
5. Sling Psychrometer.
6. Smoke Candles and Smoke Generator.
7. Flowhoods with hoods to match air outlet sizes used on project.

C. Hydronic Balancing Instruments:

1. Calibrated Test Gages: Ranges 0 to 30 lbs., 0 to 60 lbs., 0 to 200 lbs.
2. Calibrated Test Gages (Compound Type): Ranges from -30" to 30 lbs. and -30" to 60 lbs.
3. U Tube Manometer: 36".

D. Air and Hydronic Systems Balancing Instruments:

1. Thermometers: 12" mercury column type and dial type, with a range of -40 to +120 degrees F. and 0 to 220 degrees F. Total of four thermometers.
2. Universal Hand Tachometer: Herman H. Sticht Type UH.
3. Stop Watch.
4. Stroboscope.
5. Contact Pyrometer: Thermocouple type.
6. Volt-Ohm-Ammeter Test Kit, High Current Type: Sperry "Ohmprobe".
7. Volt-Ammeter: With leads for connecting to lugs.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Inspection: Prior to the environmental testing and balancing of hydronic and air distribution systems, the certified supervisor in the employ of the testing and balancing agency shall inspect the installations and notify the Owner's Representative of any Work which must be performed or modified prior to initiating testing and balancing procedures.
- B. Performance: Test and balance environmental hydronic and air distribution systems, including all connected equipment and apparatus, so as to conform to the design conditions. Perform the Work of this section in accordance with the published standards of the balancing council or bureau, which is certifying the member firm. Record all test readings, calculations and results.

END OF SECTION 230594

SECTION 230713 - DUCT INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Common Work Results for HVAC: Section 230500
Ductwork Accessories: Section 233300

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Insulation Schedule: Schedule shall list all systems and indicate by system the type of insulation, jacketing, etc, to include manufacturer's model number and size for each service application.
- C. Product Data for each Insulation type. Manufacturer's catalog sheets, specifications, and installation instructions for each item specified, excluding Miscellaneous Materials.

1.4 QUALITY ASSURANCE

- A. Qualifications: The persons and supervisors performing the Work of this section shall be personally experienced in installing insulation and shall have been regularly performing such work for a minimum of 3 years while in the employ of a company or companies engaged in the installation of piping insulation.
- B. Regulatory Requirements:
 - 1. Fire and Smoke Hazard Ratings: Duct insulation installed inside a building, duct lining materials, Class 1 and 2 jacketing materials, mastics, and adhesives shall have a maximum flame spread rating of 25 and a maximum fuel contributed and smoke developed rating of 50 or less, when tested in accordance with ASTM E84 and UL723.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

- A. Insulation for ductwork shall be fibrous glass with a factory applied laminated foil - scrim - kraft jacket of Class as specified and as follows:
1. (Type-1) Fiberglass Board insulation with a factory applied Class 1 jacket. Preformed, flat, rectangular rigid material, R-Value as specified, having a density of 3.0 pcf, a thermal conductivity (k value at 75 degrees F.) of 0.23 conforming to ASTM C612, with a factory applied Class 1 jacket.
 2. (Type-2) Fiberglass Flexible Board insulation with a factory applied Class 1 jacket. Preformed, flat, rectangular rigid material, R-Value as specified, having a density of 3.0 pcf, a thermal conductivity (k value at 75 degrees F.) of 0.23 conforming to ASTM C612, with a factory applied Class 1 jacket.
 3. (Type-3) Fiberglass Blanket insulation with a factory applied Class 2 jacket. Roll type, flexible material, R-Value as specified, having a density of 1.0 pcf, a thermal conductivity (k value at 75 degrees F.) of 0.27, conforming to ASTM C553 with a factory applied Class 2 jacket.
 4. (Type-4) Flexible Sheet Foam Plastic insulation. Chemically expanded unicellular elastomeric material possessing the following physical characteristics: R-Value as specified. Flexible sheet form having a density of 6 pcf; a thermal conductivity (k value at 75 degrees F.) of 0.28 max.; operating temperature range of -20 to 200 degrees F., and a self-extinguishing fire resistance rating in accordance with ASTM D1692.
- B. Insulation Values: Provide the specified insulating value as required, the insulation value shall be the installed R-Value

2.2 JACKET MATERIALS

- A. When conditions permit, factory applied jacketing materials to insulation.
- B. Laminated Jacket:
1. (Class-1) Permanent, fire resistant, non-corrosive type having a UL flame spread rating of 25 or less, a fuel contributed and smoke developed rating of 50 or less, a vapor transmission rate of 0.02 perms or less. Jacket materials shall be as follows:

- i. (Class-1) - Heavy duty 0.7 mil thick aluminum foil and white kraft paper laminate, reinforced with glass fiber scrim or fiber glass yarn, not less than 4 per inch in both directions.

2.3 ADHESIVES, SEALANTS AND CEMENTS: (Cereal base adhesives will not be accepted).

- A. Vapor Seal Adhesive: B. Foster 85-20, Childers' CP-82, or Epolux Cadaprene 400.
- B. Vapor Barrier Mastic: B. Foster 30-35, Childers' CP-30, or Epolux Cadalar 670.
- C. Joint Sealer for use with Fibrous Glass Insulation: B. Foster 30-45, Childers' CP-30 or Epolux Cadalar 670.
- D. Adhesive for Flexible Foamed Plastic: Armstrong Cork Co. 520, B. Foster 82-31, Childers' CP-80 or Epolux Cadaprene 488.

2.4 MISCELLANEOUS MATERIALS

- A. Duct and Equipment Insulation Fasteners: Weld pin type complete with a speed washer, or suitable clip for supporting the insulation. Fasteners shall be Graham Weld Pins, Duro Dyne Spotter Pins or Clip Pins.
- B. Sealing Tape for Sealing Joints in Duct Insulation: Same materials as the jacket, as manufactured by Arno Adhesive Tapes, Inc., Compac Corp., Fasson or Morgan Adhesive Company.
- C. Metal Corner Angles: 2" x 2" x 28 gage galvanized sheet metal.
- D. Prefabricated Metal Corner Angle Tape: Minimum 28 gage flexible metal bonded to vapor barrier material of the same Class as the insulation jacketing material.
- E. Ductwork Insulation Filler Pieces: Preformed, flat, rectangular material, of thickness as specified, having a density of 6 pcf, conforming to ASTM C612.

PART 3 EXECUTION

3.1 PREPARATION

- A. Preliminary Work: Clean and dry ductwork, prior to insulating.

3.2 INSTALLATION, GENERAL

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, except as specified otherwise

3.3 INSTALLATION

- A. General: Provide insulation as scheduled below, as a minimum, insulate all HVAC systems provided in this project in compliance with 2020 Energy Conservation Construction Code of New York State. Where the insulation scheduled or noted in the construction documents exceeds the Energy Code, the greater requirement shall be provided. HVAC Systems provided but not indicated in the schedule below, however require insulation per the Energy Code, shall be provided as part of this project.

APPLICATION	MAT'L	THICKNESS / [Min. R-VALUE]	JACKET	ADD'L
Supply / Ventilation Duct				
Above ceilings	Type-3	2" [R-6]	Class-1	
Above ceilings, under insulated roofs.	Type-3	2" [R-6]	Class-1	
Above insulated ceilings, under roofs	Type-1	3" [R-12]	Class-1	
Exposed in finished spaces (1)	Type-1	1-1/2" [R-6]	Class-1	
Exposed in un-finished spaces (2)	Type-1	1-1/2" [R-6]	Class-1	
Exterior of the building, Rectangular duct construction.	Type-1	3" [Min R-12] (7)	Class-1	
Exterior of the building, Round duct construction	Type-1	3" [R-12]	Class-1	
Exposed in un-conditioned spaces	Type-1	1-1/2" [R-6]	Class-1	
Non accessible, un-conditioned spaces (4)	Type-1	3" [R-12]	Class-1	
Return Duct				
Above ceilings	None			
Above ceilings, under insulated roofs.	None			
Above ceilings, return air plenums	None			
Above insulated ceilings, under roofs	Type-1	3" [R-12]	Class-1	
Exposed in finished spaces (1)	Type-1	1-1/2" [R-6]	Class-1	
Exposed in un-finished spaces (2)	Type-1	1-1/2" [R-6]	Class-1	
Exterior of the building, Rectangular duct construction.	Type-1	3" [Min R-12] (7)	Class-1	
Exterior of the building, Round duct construction	Type-1	3" [R-12]	Class-1	
Exposed in un-conditioned spaces	Type-1	1-1/2" [R-6]	Class-1	
Non accessible, un-conditioned	Type-3	3" [R-12]	Class-1	

spaces (4)				
OA Duct				
Above ceilings	Type-3	2" [R-6]	Class-1	
Exposed in finished spaces	Type-1	1-1/2" [R-6]	Class-1	
Exposed in un-finished spaces (2)	Type-1	1-1/2" [R-6]	Class-1	
Exposed in un-conditioned spaces (3)	Type-1	1-1/2" [R-6]	Class-1	
Non accessible, un-conditioned spaces (5)	Type-3	3" [R-6]	Class-1	
Exposed in un-conditioned OA mixed with RA	Type-1	1-1/2" [R-6]	Class-1	
OA mixed with RA Duct (8)				
Above ceilings	Type-3	2" [R-6]	Class-1	
Exposed in finished spaces	Type-1	1-1/2" [R-6]	Class-1	
Exposed in un-finished spaces (2)	Type-1	1-1/2" [R-6]	Class-1	
Exposed in un-conditioned spaces (3)	Type-1	1-1/2" [R-6]	Class-1	
Non-accessible, un-conditioned spaces (5)	Type-3	2" [R-6]	Class-1	
Exposed in un-conditioned OA mixed with RA	Type-1	1-1/2" [R-6]	Class-1	
Exhaust Air Duct				
Above ceilings (6)	Type-3	2" [R-6]	Class-1	
Exposed in finished spaces (6)	Type-1	1-1/2" [R-6]	Class-1	
Relief Air Duct				
Above ceilings (6)	Type-3	2" [R-6]	Class-1	
Exposed in finished spaces (6)	Type-1	1-1/2" [R-6]	Class-1	

Comments

- 1) Ductwork serving the same space in which it serves, and is exposed to view, duct insulation is not required. When ductwork is exposed to view, but does not serve the space where exposed, ductwork shall be insulated as scheduled.
- 2) Unfinished spaces, which are considered utility use, such as: Boiler rms, mechanical equipment, fan rms, electrical rms, store rms, janitor, basements, and service passages.
- 3) Un-conditioned spaces: which have no heating or cooling means, such as garages, loading docks.
- 4) Provide jacket to 96" AFF.

- 5) Non-accessible and unconditioned spaces: crawl spaces, above ceilings of spaces not conditioned
- 6) Ductwork between exterior of the building and damper (control or back draft).
- 7) Provide on flanged duct, one layer 1-1/2" board without vapor barrier between duct flanges followed by a continuous layer of 1-1/2" board with vapor barrier, with the exterior membrane wrap applied.
- 8) OA mixed with RA, defined as: OA non-tempered outside air (IE: heated or cooled by mechanical means) combined with RA (return air) ductwork.

B. Board Insulation:

1. Board Insulation Application:

- a. Secure insulation to ductwork, with duct insulation fasteners spaced 3" in from all corners of ducts, with intermediate fasteners on maximum 16" centers in all directions. Butt all edges of insulation and fill all voids with similar insulation.
- b. Install board type insulation with a Class 1 jacket. When ductwork cross seams, angle bracing or reinforcing are higher than the insulation thickness, increase insulation thickness to be equal to or greater than the H (height) dimension of the cross seam, angle bracing or reinforcing member.
- c. Seam minimum 1½" wide longitudinal jacket laps continuously with vapor barrier lap adhesive. Lap circumferential joints with 4" wide jacket material and seal laps continuously with vapor barrier lap adhesive, or seal continuously with a minimum 3" wide pressure sensitive sealing tap, of the same material as the jacket. Install metal corner angles or prefabricated corner angle tape, over the jacketed insulated corners. Seal exposed ends of insulation with vapor barrier mastic. Vapor seal all breaks in vapor barrier jacketing, all exposed surfaces of duct insulation fasteners and metal corner angles, with pressure sensitive sealing tape of the same material as the jacket or coat with vapor barrier mastic.
- d. Trapeze Hangers: Place trapeze hangers, fabricated of steel rods and structural steel channels or angles, outside the jacketed insulated ducts. Install high-density insulation pieces, of thickness equal to the insulation, a minimum of 4" in width by the bottom dimension of the duct, at all points of support. Continuously jacket all insulated ducts and filler pieces through all supports.
- e. Miscellaneous Board Insulation Application: Insulate air handling equipment, not furnished with a factory applied insulated jacket or internal insulation as specified under sections of this specification, with fibrous glass board with a Class 1 jacket, installed and finished as specified for exposed ductwork in a finished space.

- f. Provide Flexible board: When surface applications are not conducive for the use rigid board insulation. For use on round or radius equipment or ductwork. Application of flexible board insulation shall be as directed for rigid board application.

C. Blanket Insulation:

1. Blanket Insulation Application: Install insulation with all longitudinal joints overlapped a minimum of 2" and butt or lap all circumferential joints. Secure longitudinal and circumferential joints with flare door staples. Install duct insulation fasteners on the bottom side of all horizontal duct runs, when the bottom dimension of the duct is in excess of 32" in width. Install duct insulation fasteners on the sides of all duct risers having a dimension over 24" in size. Space fasteners in accordance with the following schedule:

DUCT DIMENSION	SPACING OF FASTENERS (Min.)
Up to 32"	None required on horizontal runs, 1 row – 16" on center on all duct riser sides over 24" in size.
33" to 48"	2 rows – 16" on centers
49" to 60"	3 rows – 16" on centers
61" and over	16" on center in all directions.

2. Trapeze Hangers: Place trapeze hangers, fabricated of steel rods and structural steel channels or angles, outside the jacketed insulated ducts. Install high-density insulation pieces, of thickness equal to the insulation, a minimum of 4" in width by the bottom dimension of the duct, at all points of support. Continuously jacket all insulated ducts and filler pieces through all supports.

D. Bench Insulated Ductwork:

1. Insulate ducts prior to erection in place when ducts are required to be installed proximate to walls, ceilings, equipment, structural steel or other ductwork, which will not permit adequate space for the installation of insulation, at a later date. Exercise reasonable care in the installation of bench insulated ductwork, so that insulated surfaces are in perfect condition before and after installation.

3.4 SCHEDULE OF ITEMS NOT TO BE INSULATED

- A. Do not insulate the following ductwork items:

1. Flexible fabric ductwork connections.

Note: Provide exterior duct insulation on lined ductwork. The exterior duct insulation R-value may be reduced such that the minimum combined R-value of the liner and ext insulation meets or exceeds minimum required R-value.

3.5 FIELD QUALITY CONTROL

- A. Field Samples: The Owner's Representative may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Re-insulate sample cut areas.

END OF SECTION 230713

SECTION 230719 - PIPING INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Pipe Hangers and Supports: Section 230529.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Insulation Schedule: Schedule shall list all systems and indicate by system the type of insulation, jacketing, etc, to include manufacturer's model number and size for each service application.
- C. Product Data for each Insulation type. Manufacturer's catalog sheets, specifications, and installation instructions for each item specified, excluding Miscellaneous Materials.

1.4 DEFINITIONS

- A. Cold Service Insulation: Insulation on piping and/or equipment conveying fluids at below ambient temperatures.
- B. Hot Service Insulation: Insulation on piping and/or equipment conveying fluids at above ambient temperatures.
- C. Dual temperature service shall follow cold service requirements.

1.5 QUALITY ASSURANCE

- A. Qualifications: The persons and supervisors performing the Work of this section shall be personally experienced in installing insulation and shall have been regularly performing such work for a minimum of 3 years while in the employ of a

company or companies engaged in the installation of piping insulation.

B. Regulatory Requirements:

1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

PART 2 PRODUCTS

2.1 INSULATION

A. (Type-A) Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.

1. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM 547:
 - a. Class 1 (Suitable for Temperatures Up to 450 degrees F): K of 0.26 at 75 degrees F.
2. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75 degrees F; ASTM C 547, Class 1.
3. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75 degrees F; ASTM C 553, Type III.
 - a. Suitable for temperatures up to 450 degrees F.

B. (Type-B) Flexible Elastomeric Foam Insulation:

1. FM tested and approved, meeting the following:
 - a. Maximum Water Vapor Transmission: 0.10 perm - inch based on ASTM E 96, Procedure A.
 - b. K of 0.27 at 75 degrees F based on ASTM C 518 or C 177.
 - c. Fire Spread/Smoke Developed Rating: 25/50 or less based on ASTM E 84.
2. Pipe Insulation: ASTM C 534, Type I.
3. Polyethylene and polyolefin insulation is not acceptable.

2.2 JACKET MATERIAL

- A. All Purpose Jacket: Vapor barrier type, factory or field applied over fiberglass insulation, comprised of a Kraft paper outer cover bonded to aluminum foil, and reinforced with fiberglass yarn. Jacket material shall be treated for permanent fire

and smoke resistance. A vapor barrier jacket seal shall be accomplished with a 1-1/2" longitudinal flap, and 3" wide butt strips, factory supplied, for making circumferential joints.

1. Fire and Smoke Hazard Classification Rating (composite, including jacket and adhesive, ASTM E-84):
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
2. Water Vapor Permeability (ASTM E-96): 0.02 perm.
3. Tensile Strength: 40 lb./in. width.
4. Mullen Burst: 70 psi.

2.3 FITTING INSULATION

A. Fiberglass Insulation System:

1. Pre-molded fitting insulation: Same thickness as the adjacent pipe covering.
 - a. Conform to FS-HH-I-558C, Form E, Class 16.
2. PVC/Fiberglass Fitting Insulation: Polyvinyl chloride pre-molded flexible fitting cover with batt type, pre-cut fiberglass insert.
 - a. PVC: Conform with FS L-P-535C, Composition A, Type II, Grade GU.
 - b. Fiberglass: Conform with FS HH-I-558C, Form B, Type I, Class 7&8.
3. Miter Cut Fitting Insulation: Fabricated from materials employed for pipe insulation.

B. Flexible Elastomeric Foam Insulation System: Miter cut fitting insulation, fabricated from materials employed for pipe insulation.

2.4 MISCELLANEOUS MATERIALS

A. Adhesive:

1. Vapor Barrier Jacket Adhesive: Foster Products Division, 85-20, Childers, CP-82, Epolux, Cad-o-prene, 400.
2. Reinforcing Membrane Adhesive: Foster Products Division 30-36; Childers, CP-50; Epolux, Cadalag 336.
3. Flexible Elastomeric Foam Adhesive: Foster Products Division, 85-75; Epolux, Cad-o-prene, 488; Armstrong, 520.

B. Joint Sealant for Fiberglass Insulation: Foster Products Division, 30-45; Childers, CP-30; Epolux, 670.

- C. Vapor Barrier Coating: Foster Products Division, 30-35; Childers, CP-30; Epolux, 670.
- D. Cement:
 - 1. Insulating Cement: ASTM C195, asbestos free.
 - 2. Finishing Cement: ASTM C449/C449M.
- E. Reinforcing Membrane:
 - 1. Polyester Cloth: 8 x 8 mesh per sq. in., 0.7 oz. per sq. yd.; Foster Products Division, Mast-a-fab.
 - 2. Glass Yarn Cloth: 20 x 20 mesh per sq. in.; Johns-Manville, Duramesh fabric.
- F. Sealing Tape: Vapor barrier, color matching, of same material as the pipe or fitting cover to which applied; as manufactured by Arno Inc., Compac Corp., Fasson Adhesive Co.; or as recommended by the manufacturer of the jacket material to which applied.
- G. Banding Wire: Steel, 20 gauge, galvanized; annealed.
- H. Thumb Tack Fastener: Stainless steel, with serrated shank.
- I. Insulation Inserts (for Hangers and Supports):
 - 1. Inserts, High Density Insulation for use with Fibrous Glass Insulation:
 - a. Cold Service Piping:
 - i. Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.
 - b. Hot Service Piping:
 - i. Calcium Silicate: Minimum density 15 pcf, K of 0.50 at 300 degrees F; ASTM C 533.
 - ii. Perlite: Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C 610.
 - 3. Inserts for use with Elastomeric Foam Insulation only:
 - a. Cold and Hot Service Piping:
 - i. Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.
- J. Wood Blocks: Hardwood, preservative treated; 1" wide, 3" minimum length; inner

and outer surfaces contoured to fit the curvature of the pipe, and insulation shield. Wood blocking is not acceptable for use on heating systems with fiberglass insulation, and will require removal if used.

- K. Wood Dowel Plugs: Hard wood, preservative treated.
- L. Wood Preservative: Pentachlorophenol, 5% solution, 3 minute dip.

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not install insulation until the piping Work has been tested and accepted.
- B. Clean and dry all Work to be insulated prior to applying insulation.

3.2 INSTALLATION, GENERAL

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, except as specified otherwise.

3.3 INSTALLATION OF FIBERGLASS INSULATION

- A. Seal jacket longitudinal flap with vapor barrier jacket adhesive. Rub out all wrinkles and smooth excess sealant flush with outer surface of jacket.
- B. Apply a coating of vapor barrier jacket adhesive to butt ends of each section of insulation to be joined, and apply butt strips in like manner as above. Apply butt strips to overlap 1-1/2" on each side of the sections joined.
- C. PVC/Fiberglass Fitting Insulation: Tuck the ends of the pre-cut insulation batt snugly into the throat of the fitting, tuft and tuck-in the edges adjacent to the pipe insulation. Install fitting cover and seal as follows:
 - 1. Cold Service Insulation: Seal the overlap in the throat of the fitting cover, and the butt joint of the cover with the adjacent pipe insulation, with vapor barrier mastic and 2" wide sealing tape (a product of the fitting cover manufacturer). Extend the tape 1" over the adjacent pipe insulation and overlap upon itself at least 2" on the downward side.
 - 2. Hot Service Insulation: Secure the cover with staples, thumb tack fasteners, or sealing tape.

- D. Pre-Molded and Miter Cut Fitting Insulation: Insulate to the same thickness as the adjoining pipe insulation. Apply joint sealant to the mating edges of the sections, and to the butt joint. Secure sections together with banding wire; bend twisted ends into the insulation. Apply a leveling coat of insulating cement to fill the voids and smooth irregularities.
 - 1. Cold Service Insulation: Cover fitting insulation with two 1/8" thick applications of vapor barrier coating, with a layer of reinforcing membrane bedded between coats. Lap membrane at least 2" over itself, and the adjacent pipe insulation. Apply a 6 ounce canvas jacket over the fitting, secured with adhesive. Lap canvas at least 2" over itself, and the adjacent pipe insulation.
 - a. Omit canvas on concealed installations.
 - 2. Hot Service Insulation: Apply a 6 ounce canvas jacket to the fitting insulation, secured with adhesive. Lap canvas at least 2" over itself.
 - a. Omit canvas on concealed installations.
- E. Vapor Stop for Cold Service Insulation:
 - 1. Pipe Insulation: At 21 foot intervals of horizontal, and 9 foot intervals of vertical pipe insulation, also at each fitting insulated with pre-molded or miter cut fitting insulation, apply a 1/16" thickness of vapor barrier coating to the butt end, and 2" into the bore of each joining section before assembling.
 - 2. Insulation Termination; Metal to Insulation Joints; Protrusions Through Insulation:
 - a. Apply a vapor barrier coating to completely seal the joint and extend over adjacent insulation and metal a maximum of 3 inches.
 - b. Embed reinforcing membrane into the coating, covering the complete coated surface; smooth out wrinkles.
 - c. Apply a heavy application of vapor barrier coating over the entire surface, leaving a large bead or fillet at the joint between metal and insulation.
- F. Insulated Piping Exposed to view in finished spaces:
 - 1. Provide PVC pipe and fitting jacketing, from 8'-0" aff or finished ceiling (which ever is higher) down to point of concealment.

3.4 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

- A. Where possible, slip insulation over the pipe, and seal butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and install; re-seal

with adhesive, making sure the mating surfaces are completely joined.

- B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer, and assemble the cut sections in accordance with the manufacturer's printed instructions.
 - 1. Insulate threaded fittings and valves with sleeved fitting covers. Over lap and seal the covers to the adjoining pipe insulation.
- C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier of the system.
- D. Insulated Piping installed exterior to the building, exposed to the elements:
 - 1. Pipe supports shall not be in direct contact with pipe, supports must to the exterior of the insulation and jacketing.
 - 2. Apply two coats of weatherproof mastic, on piping where the insulation OD is 3" or less.
 - 3. Provide continuous PVC pipe and fitting jacketing on piping where the insulation OD is 4" or larger, caulked / sealed weather tight, from exit point of building to termination point (to include termination connections).

3.5 INSTALLATION AT HANGERS

- A. Reset and realign hangers and supports if they are displaced while installing the piping insulation.
- B. Direct hanger or clamp contact of pipe for hot or cold piping is not allowed.
- C. Fiberglass Insulation: Install high density insulation filler pieces, at all points of support, between pipe insulation shields and pipe or tubing on pipe or tubing 2" and larger. Do not install high-density insulation filler pieces on piping or tubing scheduled to have steel saddles. Install filler pieces of the same thicknesses as adjoining pipe insulation and 2" longer than the insulation shield of the following materials:
 - 1. Install high density molded polyurethane or high-density polystyrene filler pieces, for pipe or tubing insulated with fibrous glass.
- D. Flexible Elastomeric Foam Insulation: Install wood blocking or wood dowel plug filler pieces of the same thickness as the insulation. Slot the insulation, insert the

filler pieces between the pipe and insulation shield, and secure in place with adhesive. Install filler pieces as follows:

PIPE/TUBING SIZE	FILLER PIECES	POSITION
Thru 1½"	2 dowel plugs	6 o'clock; in tandem
2" thru 4"	1 block 2 dowel plugs	6 o'clock, and 4&8 o'clock, respectively
6" thru 8"	2 blocks 4 dowel plugs	6 o'clock; in tandem and 4&8 o'clock; in tandem

3.6 INSULATION SCHEDULES

- A. General: Provide insulation as scheduled below, insulate all HVAC systems provided in this project in compliance with NYS Energy Code. Where the insulation scheduled or noted in the construction documents exceeds the Energy Code, the greater requirement shall be provided. HVAC Systems provided require insulation per the Energy Code, but not indicated in the schedule below, shall be insulated as part of this project..

APPLICATION	PIPE SIZE	TYPE	MINIMUM THICKNESS	ADD'L
Hot Water (HWS & HWR)	1-1/4" or less	A	1½"	
	1-1/2" and above	A	2"	
Steam (LPS, up to 15 psig)	3" or less	A	2½"	
	4" and above	A	3"	
Steam Condensate (LPR, LPC)	3" or less	A	2½"	
	4" and above	A	3"	
Condensate Drain (CD)	All	A	1/2"	
Refrigerant	1-1/4" or less	B	1½"	
	1-1/2" and above	B	2"	
Cold Services: Equipment, vessels and appurtenances for conveying, storing or processing materials, at or below ambient temperature	All	A or B	1½"	

Hot Services: Equipment, vessels and appurtenances for conveying, storing or processing materials, at or above ambient temperature	All	A or B	1½"	
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Insulate all cold and hot service equipment in accordance with the schedule, except the items listed below:

- A. Air vents, pressure reducing valves, pilot lines, safety valves, relief valves; back pressure valves.
 - B. Flexible connectors.
 - C. Piping buried in the ground, unless otherwise specified herein.
 - D. Items installed by others, unless otherwise specified herein.
- B. Install all cold and hot service insulation intact through pipe sleeves, and openings in building construction, maintaining the vapor barrier integrity of the system.
- C. Insulate valve bodies up to but not including the packing nuts.
- D. Flanges and mechanical couplings and fittings (grooved fittings) shall be insulated with the insulation thickness specified for that system. Provide molded PVC fitting on all grooved fittings.
- E. Coordinate with the equipment manufacturers requirements, provide field insulated equipment components or system components as recommended (IE: refrigerant line, boiler headers, cross over piping, etc) per manufacturer.
- F. Insulation Options: Select only one of the first 3 options for fiberglass pipe and/or equipment insulation. Option 4 may be used for temperatures to 200 degrees F and on sizes of 2 inches and under. Use fiberglass on pipe and equipment sizes of 2-1/2 inches and larger. Do not inter mix insulation types on individual runs of piping.
 - 1. Option 1: Fiberglass pipe and/or equipment insulation, with pre-molded fitting insulation.
 - 2. Option 2: Fiberglass pipe and/or equipment insulation, with PVC/fiberglass fitting insulating system.
 - 3. Option 3: Fiberglass pipe and/or equipment insulation, with miter cut fitting insulation.

3.7 FIELD QUALITY CONTROL

- A. Field Samples: The Owner's Representative may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Re-insulate sample cut areas.

END OF SECTION 230719

SECTION 230923 – DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Mechanical Division 23
230993 - Sequence of Operations for HVAC Controls
Electrical Division 26

1.3 SCOPE OF WORK

- A. Furnish all labor, materials, tools, equipment, and services for a fully integrated and networked energy management control system (EMS) as indicated, in accordance with provisions of contract documents.
- B. The EMS shall be an extension of the existing district-wide Schneider Electric Energy Management System.
- C. Interface to the EMS shall be via the Owner's existing operator workstation and existing web browser interface. All existing and new functions shall be accessible via the local network and the internet.
- D. Provide system graphics for all controlled equipment, each controlled device and floor plan and integrated system. New graphics layout and appearance shall match Owner's existing Schneider Electric system graphics. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the EMS.
- E. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intents of this specification, shall be included in Contractor's bid and provided without additional cost to the Owner.
- F. A post-bid interview and technical review with the Owner and the Engineer may be required prior to contract award. During this interview the contractor will be

required to demonstrate that their proposed solution and specific plan regarding the integration of their controllers with the Owner's Schneider Electric Operator Workstation and existing control system and network fulfills the contract requirements to the satisfaction of the Owner.

1.4 QUALITY ASSURANCE

- A. The EMS shall be installed by competent mechanics and checked out by competent technicians regularly employed by the manufacturer of the equipment or licensed franchises authorized by the manufacturer.
- B. Single source responsibility shall include installation, calibration, and check-out of the stand-alone systems and network.
- C. The EMS installer shall have an in-place, local support facility with technical staff, spare parts inventory, and all necessary test diagnostic equipment.

1.5 REFERENCED STANDARDS, CODES AND ORDINANCES

- A. The latest issue of applicable standards and recommended practices of the following agencies in effect shall form a part of the specification to the extent each agency's relative standards or recommended practices apply to the Systems and its components as specified herein.
 - 1. Federal Communications Commission (FCC)
 - 2. American National Standards Institute (ANSI)
 - 3. American Society of Mechanical Engineers (ASME)
 - 4. Electronic Industries Association (EIA)
 - 5. Institute of Electrical and Electronics Engineers (IEEE)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. National Fire Protection Association (NFPA)
 - 8. Underwriters Laboratories (UL)
 - 9. Occupational Safety and Health Administration (OSHA)
 - 10. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- B. All systems equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag

number (if any), and the UL label as applicable. All systems components of a given type shall be the product of the same manufacturer.

1.6 SUBMITTALS & OPERATION AND MAINTENANCE MANUALS

- A. Provide eight (8) copies of shop drawings of the entire control system and submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Control shop drawings shall be on 11"x17" paper and shall contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system.
- B. All control system components shall be shown on control shop drawings and shall be identified in respective shop drawing bill of material. Bills of material shall include brief description of each system component, component part number and component device tag.
- C. Over- and under-voltage protection apparatus for all system controllers as specified in Power Supplies and Power Conditioning later in this document shall be shown on the control shop drawings and identified in the bills of material.
- D. Wiring diagrams and layouts for each control panel and terminal identification for all control wiring shall be shown on the control shop drawings.
- E. A complete written Sequence of Operation and input/output points list of all points connected to the DDC system shall be included for each piece of controlled equipment. This information shall be located on the associated system control shop drawing or on the page immediately following if the information will not fit on the system drawing.
- F. Label control shop drawings and title blocks descriptive of controlled equipment shown on the shop drawing. Do not label shop drawings to match mechanical drawing numbers.
- G. Clearly reference covered specification and drawing on each submittal. Product submittals shall consist of a complete list of equipment and materials, including manufacturer's catalog data sheets and installation instructions. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate specific data for the product being submitted by highlighting or by other means. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work.

- H. Product submittals shall include manufacturer's product data and specifications for any Operator Workstation; Web browser user interface server or workstation and software; portable operator's terminal; uninterruptible power supply; printer; and networking equipment provided as part of the EMS.
- I. Submittal shall include a system schematic riser diagram depicting the building OWS; printers; browser user interface computers / peripherals; Network Area Controllers (NAC); standalone EMS controllers, 3rd party controllers; and the networking equipment required to make a complete and functional system.
- J. Upon completion of the work, provide three (3) hardcopy sets of Operation and Maintenance Manuals to the Owner's representative. The entire Operation and Maintenance Manual shall also be furnished on compact disk media. The manuals shall include the following for the EMS provided:
 - 1. Table of contents.
 - 2. As-built system record drawings. Computer Aided Drawings (AutoCAD 2006 or newer) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - 3. As-built versions of manufacturers' product data sheets for all products including software.
 - 4. System Operator's manuals with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - 5. Licenses, guarantees and warranty documents for equipment and systems.
 - 6. EMS network diagrams.
 - 7. Wiring termination schedules.
 - 8. Interfaces to all third-party products and work by other trades.
 - 9. List of recommended spare parts with part numbers and suppliers.
 - 10. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning and calibration; time between tasks; and task descriptions.
- K. As-built software documentation shall be provided on a CD and include the following:
 - 1. Descriptive point lists.

2. Application program listing.
 3. Application programs with comments.
 4. Printouts of all reports.
 5. Alarm list.
 6. Printouts of all graphics.
- L. The Operation and Maintenance Manual CD shall be self-contained and include all necessary software required to access the project record drawings, data sheets, spare parts list and maintenance procedures. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoom and search all documents.
- M. On-line Documentation: After completion of all the tests and adjustments listed above, the contractor shall install the following information on the EMS:
1. "AS-BUILT" drawing files
 2. Detailed catalog data on all installed system components
 3. Address and phone number of factory repair service contact

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 ACCEPTABLE SUPPLIERS/MANUFACTURERS:

Schneider Electric (Day Automation)

2.3 POWER FAIL / AUTO RESTART

- A. Provide for the automatic orderly and predefined shutdown of parts of or the entire EMS following total loss of power to parts of or the entire EMS.
- B. Provide for the automatic orderly and predefined startup of parts of or the entire EMS following re-establishing of power to parts of or the entire EMS.

- C. Maintain the EMS real-time clock operation during periods of power outage for a minimum of 72 hours.
- D. Refer to additional Power Fail / Auto Restart requirements in the Sequence of Operation section.

2.4 POWER SUPPLIES & POWER CONDITIONING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
- B. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
- C. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- D. Line voltage units shall be UL recognized and CSA listed.
- E. All system controllers, with the exception of the room VAV box controllers, shall be provided with power conditioning, over-voltage and under-voltage protection. Under-voltage protection shall be provided by voltage sensing relays (refer to HVAC field devices) or an uninterruptible power supply sized appropriately by EMS contractor for its protected controllers.

2.5 HVAC FIELD DEVICES:

- A. Motorized Control Dampers provided by EMS contractor unless otherwise noted. Refer to section 230910 for specifications.
- B. Control Damper Actuators: Spring-return actuators installed for fail-safe action are required for all dampers. Unless otherwise specified in the Sequence of Operation or on the drawings, dampers utilized in outside, relief and exhaust air applications shall be fail-safe closed; dampers utilized in return air applications shall be fail-safe open; combustion air dampers and emergency generator intake and exhaust air dampers shall be fail-safe open. Actuators shall be electric/electronic sized to match the application with adequate power to operate smoothly and provide tight close-off. Two-position or proportional

electric/electronic actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation. Actuators shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS). Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications.) 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring. Operators shall be able to manually position each actuator when the actuator is not powered. Spring-return actuators with more than 60 in.-lb torque capacity shall have a manual crank. Provide one actuator per damper section at a minimum. EMS contractor shall provide all damper actuators unless otherwise specified elsewhere. Low voltage and line voltage wiring to actuators is considered control wiring and shall be provided by the EMS contractor.

- C. Control Valves: Spring-return, fail-open action is required for all heating and cooling coil control valves on any equipment that has an outside air source unless otherwise specified in the Sequence of Operation. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown. Water service control valves shall be 2-way or 3-way pattern as specified or shown on the drawings and shall provide tight shutoff against system design pressures and differentials (150% of total pump head for 2-way valves and 100% for 3-way valves). Two-position valves shall be "line" size. Proportional control valves for water service shall be sized for a maximum pressure drop of 3.0 psi at rated flow (except as may be noted on the drawings). Proportional control valves for steam service shall be sized as appropriate for the application and the inlet steam pressure. Valves providing modulating service shall have equal percentage ports. Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. All actuators shall be sized for tight shut-off against system pressures and furnished with integral switches for indication of valve position (open-closed). Electric bi-directional actuators are acceptable on VAV terminal units and room reheat coil valve control. All electric actuators for applications other than VAV terminal units and room reheat coil valve control shall be proportional analog 4-20Ma or 0-10Vdc input. Three-way butterfly valves, when utilized, shall include a separate actuator for each butterfly segment. Low voltage and line voltage wiring to actuators is considered control wiring and shall be provided by the EMS contractor.
- D. Wall Mount Room Temperature Sensors: Each room temperature sensor shall provide temperature indication to the digital controller and provide the capability for a software-limited set point adjustment and operation override capability. An

integral LCD shall annunciate current room temperature and set point as well as override status indication. In addition, the sensor shall include a port for connection to a portable operator's terminal. Sensors shall be mounted at 54 inches AFF unless indicated otherwise on drawings.

- E. Duct Mount, Pipe Mount and Outside Air Temperature Sensors: 10,000-ohm thermistor temperature sensors with an accuracy of $\pm 0.2^{\circ}\text{C}$. or two wire RTD type with nickel wound elements with a minimum of 1000 ohm reference resistance and a minimum accuracy of $\pm 0.5^{\circ}\text{F}$. Outside air sensors shall include an integral sun shield and be mounted on a northern exposure. Immersion sensors shall be provided with a separable brass or stainless steel well, as required by the application. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
- F. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- G. Power Monitoring Interface: The Power Monitoring Interface (PMI) device shall include the appropriate current and potential (voltage) transformers. The PMI shall be certified under UL-3111. The PMI shall perform continuous true RMS measurement based on 32 samples-per-cycle sampling on all voltage and current signals. The PMI shall provide outputs to the EMS based on the measurement and calculation of the following parameters: (a) current for each phase and average of all three phases, (b) kW for each phase and total of all three phases, (c) power factor for each phase and all three phases, (d) percent voltage unbalance and (e) percent current unbalance. These output values shall be hard-wired inputs to the EMS or shall be communicated to the EMS over the open-protocol LAN.
- H. Water flow meters shall be single turbine insertion-type with frequency output complete with hot-tap isolation valves to enable sensor removal without water supply system shutdown. Accuracy shall be $\pm 0.5\%$ of reading at calibrated velocity. Frequency output 0-15V peak pulse. Meters shall be fully compatible for use as a system with BTU meters as specified below. Flow meter shall be Onicon F-1100, or approved equal.
- I. BTU meters shall come complete with temperature sensors and thermowells and be fully compatible for use as a system with water flow meters as specified above. Differential temperature accuracy shall be $\pm 0.15^{\circ}\text{F}$ over calibrated range. Non-volatile EEPROM memory shall retain all program parameters and totalized values in the event of power loss. Alphanumeric LCD shall display total energy, total

flow, energy rate, flow rate, supply temperature and return temperature. Standard output signal shall be isolated solid state dry contact for energy total. Provide with optional 4-20mA analog output for flow rate. BTU meter shall be Onicon System-10 BTU meter, or approved equal.

- J. Temperature Control Panels: Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door, key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel. Pre-wire internal and face-mounted device connections with color-coded stranded conductors, tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring. Each local panel shall have a control power source power switch (on-off) with over-current protection. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels.
- K. Filter differential pressure switches shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have adjustable scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified. Switches shall be piped across the filter sections and set per the filter manufacturer's recommendations.
- L. Filter differential pressure sensing device shall be indicating transmitter type designed to provide both visual monitoring at the filter location and electronic monitoring at the EMS. Transmitter shall have easily-read dial gage and two-wire, 4-20mA control signal with rear-mounted terminal strip. Transmitter shall be Dwyer Magnehelic Differential Pressure Indicating Transmitter Model 605, or approved equal with range appropriate for filter bank and shall be piped across the filter sections. EMS alarm point shall be set per the filter manufacturer's recommendations.
- M. Water flow switches: Flow-proving switches shall be differential pressure type. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum). Scale range and differential shall be suitable for intended application and NEMA 1 enclosure unless otherwise specified. Paddle-type flow switches are not acceptable.
- N. Low limit air stream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Provide one thermostat for each 25 square foot of coil area. Low limit thermostat shall be manual reset and shall be double pole so as to provide input capability for alarm at the EMS.

- O. High limit thermostats shall be located as directed and shall be manual reset type set at 120°F in the return and 180°F in the discharge. Thermostats shall be double pole so as to provide input capability for alarm at the EMS.
- P. Humidity Sensors: Wall mount sensors shall have a minimum sensing range of 0%-95%. Duct mount sensors shall have a minimum sensing range of 20%-80%. Duct mount sensors shall have a sampling chamber. Outdoor air humidity sensors shall have a sensing range of 0%-100% RH and shall be suitable for ambient conditions of -40-60deg C (-40-140deg F). Wall and duct mount humidity sensors shall be Vaisala HMD/W60/70 Series Transmitters, or approved equal. Outdoor air mounted humidity sensors shall be Vaisala HMP60 probe with DTR500 shield, or approved equal. Wall mounted sensors shall be mounted at 54 inches AFF unless indicated otherwise on drawings.
- N. Air static differential pressure transmitters shall have an overpressure rating of up to 10psi depending on range. The transmitter shall have an accuracy of not less than +/- 1.0% full scale with an operating environment of 0 to 175 deg F. Output shall be a 4-20mA. Transmitters shall be Setra Model 264, or approved equal..
- O. Liquid pressure transmitters shall be housed in a NEMA 4 enclosure with a burst pressure rating of 500% rated range and overpressure rating of 300% rated range. The transmitter shall have an accuracy of not less than +/- 1.0% full scale with an operating environment of 0 to 180°F and 10-90% RH Non-Condensing. Output shall be 4-20mA. Transmitters shall be Mamac PR-264, or approved equal.
- P. Liquid differential pressure transmitters shall be housed in a NEMA 4 enclosure with a burst pressure rating of 500% rated range, overpressure rating of 300% rated range and maximum static pressure rating of 200% of differential pressure range. The transmitter shall have an accuracy of not less than +/- 1.0% full scale with an operating environment of 0 to 180°F and 10-90% RH Non-Condensing. Output shall be 4-20mA. Transmitters shall be Mamac PR-283, or approved equal.
- Q. Steam pressure measurements shall be accurate to +/- 0.13% of range using a solid-state sensing element. The range of the instrument selected shall be 2 times the operating pressure of the sensed variable. Unit shall be provided with isolation and bypass manifold for start-up and maintenance operations. Transmitter shall be Setra model C-207, or approved equal.
- R. CO2 Sensors: CO2 sensors shall provide simultaneous analog outputs in volts and milliamps and shall have a gold bifurcated relay that can be operated as normally open or closed; sensor shall incorporate elevation correction adjustment and ABCLogic™ (Automatic Background Calibration) software for self-correction of drift to better than ±10ppm per year. Sensor shall have an accuracy of ±40 ppm or 3% of the reading (whichever is greater) @ 72°F. All adjustments to the

sensor including output scaling, elevation adjustment, relay setpoint, relay dead-band, proportional or exponential output, and single-point calibration shall be made via computer connection to an on-board RJ45 jack. Sensor shall have a detachable base with all field wiring terminals on the base. Sensor shall be suitable for wall, duct or outdoor sensing application as required. CO2 sensor shall be the GE Telaire 8001 non-dispersive infrared sensor, or approved equal. Wall mounted sensors shall be mounted at 54 inches AFF unless indicated otherwise on drawings.

- S. Control relays shall be plug-in type or encapsulated, UL listed and with coil and contact ratings suitable for the application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- T. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- U. Damper blade position limit switch shall be Kele model LS45M91B11 Whisker Switch, or approved equal. Damper actuator switches are not acceptable. Devices which only sense damper shaft position are not acceptable.
- V. Door position switch shall be a hermetically sealed reed switch nominally 3" L x 1" H x 0.50" D with matching actuating magnet. Contact and magnets shall be in brushed anodized aluminum tube housing. Contact shall be sealed. Each contact shall connect to three feet of flex stainless steel conduit. Switches shall be GE Sentrol model 2505A, or approved equal.
- W. Condensate pan high level alarm switch shall be in inline, low voltage condensate overflow shutoff pre-wired with 4-foot, 18 AWG wires. Switch shall be RectorSeal Safe-T-Switch SS1, or approved equal.
- X. Area surface moisture detection system shall be 12V or 24V AC or DC hardwire-powered with up to six surface sensor probes; form C (SPDT) 1 Amp @ 24VAC, 1 Amp @ 30VDC output; 32 to 140°F operating temperature; high humidity or condensation conditions will not cause alarm. System shall be Winland Electronics WaterBug WB-200 with W-S-U surface sensor, or approved equal.
- Y. Voltage sensing relays shall be capable of monitoring and reacting to over and under voltage conditions. Adjustable upper and lower voltage trip-points, LED indication of both presence of input voltage and when output is energized and adjustable transfer-of-contacts timing delay. Relay shall be Magnecraft 831VS-120, or approved equal.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate this section's work with work of others. EMS Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. EMS Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. EMS Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site
 - 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Test and Balance
 - 1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
 - 2. Train Test and Balance Contractor to use control system interface tools.
 - 3. Provide a qualified technician to assist with testing and balancing the first five (5) terminal units.

4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

3.4 INSTALLATION

A. General Notes:

1. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
2. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
3. Install specified temperature control equipment in Mechanical Equipment and Machine Rooms, and Penthouse Mechanical Equipment rooms in local control panels. Refer to Article entitled "Local Control Panels".
4. Install and properly support all ductstats, dial thermometers, thermostat bulbs, temperature and humidity sensors and controllers, etc., in the center of duct cross section, in a straight duct run.
5. Provide averaging type elements for sensing mixed air temperatures in ductwork, with sufficient length or sufficient number of elements, so as to efficiently measure the air temperature through the entire cross section of duct.
6. Test all electric and electronic equipment provided under this Section.

B. Provide DDC/electric-electronic control system, as noted on the drawings and as specified. Provide all necessary relays, mounting brackets, gages, switches and accessories required, even though not specifically called for, so as to result in complete workable systems.

C. All work described in this section shall be installed, wired, circuit-tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

D. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

E. Equipment furnished by the HVAC Contractor that is normally wired before

installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the EMS contractor.

- F. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.5 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations.
- B. Low voltage and line voltage wiring to actuators is considered control wiring and shall be provided by the EMS contractor unless shown otherwise on electrical drawings.
- C. Line voltage wiring to EMS controllers and equipment panels is considered control wiring and shall be provided by the EMS contractor unless shown otherwise on electrical drawings.
- D. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- E. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.
- F. NEC Class 2 (current-limited) wires not in raceway shall be plenum-rated and UL listed for the intended application.
- G. Install wiring in raceway where subject to mechanical damage and at levels below 10ft in mechanical, electrical, or service rooms.
- H. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- I. Do not install wiring in raceway containing tubing.
- J. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 10 ft intervals.

- K. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- L. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- M. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- N. Include one pull string in each raceway 1 in. or larger.
- O. Use color-coded conductors throughout.
- P. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- Q. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 6 in. between raceway and high-temperature equipment such as steam pipes or flues.
- R. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- S. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- T. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- U. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 3 ft in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- V. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.6 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring.
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. Communication wires not in raceway but in concealed and accessible locations such as return air plenums shall be plenum-rated and UL listed for the intended application.
- D. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- E. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- F. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- G. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- H. Label communication wiring to indicate origination and destination.
- I. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.7 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.

- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each square foot of coil area. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the coil.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building sensing the average atmospheric pressure at four points (North, South, East and West). Pipe high-pressure port to a location behind a thermostat cover. Provide all necessary filtering, surge dampeners, atmospheric and room static pressure sensing heads, etc., required for accurate and stable building pressurization control.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Low limit thermostats, high limit thermostats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the

sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.8 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations. Low voltage and line voltage wiring to actuators is considered control wiring and shall be provided by the EMS contractor.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations. Low voltage and line voltage wiring to actuators is considered control wiring and shall be provided by the EMS contractor.
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
 - 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 4. Provide necessary mounting hardware and linkages for actuator installation.
- C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer. Low voltage and line voltage wiring to actuators is considered control wiring and shall be provided by the EMS contractor.

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 2 in. of termination.
- B. Label pneumatic tubing at each end within 2 in. of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum ½ in. letters on laminated plastic nameplates.

- E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- F. Label room sensors related to terminal boxes or valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Label identifiers shall match record documents.

3.10 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of final system acceptance. Control system failures during warranty period shall be adjusted, repaired or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
- B. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
- C. Provide updates to operator workstation, web server software, project-specific software, graphic software, database software, and firmware at no charge to the Owner during the warranty period. Do not install updates or upgrades without Owner's prior authorization.

3.11 WARRANTY ACCESS

- A. The Owner shall grant to the EMS contractor reasonable access to the EMS during the warranty period. The owner shall allow the contractor to access the EMS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.12 ACCEPTANCE TESTING

- A. Upon completion of the installation, the EMS contractor shall load all system software and start-up the system. The EMS contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

- B. The EMS contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- D. System Acceptance: Satisfactory completion is when the EMS contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.13 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 - 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code
 - 5. Documentation

3.14 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.15 OPERATOR INSTRUCTION AND TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be eight (8) hours in duration. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, on-site training, or a combination of training methods.
- B. Training shall be tailored to the Owner's existing EMS and specific controlled

equipment and systems of this project.

3.16 FIELD QUALITY CONTROL

- A. Provide the services of a qualified engineer, in the employ of the control systems manufacturer, for the initial start-up and calibration of control systems, and the instruction of Owner's Personnel.

3.17 SOFTWARE INSTALLATION

- A. General: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.
- B. Database Configuration: The Contractor shall provide all labor to configure those portions of the database that are required by the point list and sequence of operation.
- C. Color Graphic Slides: Unless otherwise directed by the owner, the Contractor shall provide color graphic displays as depicted in the schematic drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.

3.18 COMMISSIONING AND SYSTEM STARTUP

- A. Point to Point Checkout: Each I/O device (both field mounted and those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the Engineer.
- B. Controller Checkout: A field checkout of all controllers shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the Engineer by the completion of the project.
- C. System Acceptance Testing:
 - 1. All application software shall be verified and compared against the sequences of operation. Control loops shall be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results

- and attach to the Test Results Sheet.
2. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the Engineer.
 3. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the Engineer.
 4. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

END OF SECTION 230923

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

Direct Digital Control System 230923

1.2 SUMMARY

- A. This section includes control sequences for HVAC equipment.
- B. Related section 230923- "Direct Digital Control System" contains requirements that relate to this Section.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – SEQUENCE OF OPERATION

3.1 GENERAL

- A. For each system listed provide direct digital control for the sequence of operation as stated in this section.
- B. Power Fail/Auto Restart
 - 1. Upon the restoration of power following a power loss, the EMS shall analyze the status of all controlled equipment, compare it with normal programmed scheduling and turn equipment on or off as necessary to resume normal operations.
 - 2. The EMS shall provide an orderly, staggered and predefined scheduling of return-to-normal operation of controlled equipment. The order in which equipment (or groups of equipment) is started, along with the time delay between starts, shall be user definable.
- C. Fire Alarm Shut Down: In an alarm condition, the Fire Alarm system shall shut down fans through direct interlock. The EMS shall not shut down the fans. The EMS contractor shall ensure that dampers and valves position to their fail-safe positions.
- D. All suggested setpoints and settings shall be adjustable.
- E. Provide lockable, tamper-proof, clear plastic protective guards on all room temperature sensors and thermostats located in public spaces (vestibules,

corridors, locker rooms, auditoriums, kitchens, cafeterias, etc.). Provide temperature sensors installed under flush mounted protective plates in bathrooms. Provide metal protective guards on all room temperature sensors and thermostats located in gymnasiums, mechanical equipment rooms, shipping and receiving areas, etc.

- F. For all analog measurements provide high and low limit and fault alarm indication. For all fans, pumps, etc., provide status alarm indication.
- G. Provide indication of system modes: i.e., Occupied, Unoccupied, Warmup, Cooldown, Pre-Occupancy Purge, Post Occupancy Flush, etc. Differentiate as appropriate for all systems controlled or interfaced to.
- H. All analog, binary and time variables and point information and adjustments shall be accessible via the OWS, web browser, etc.
- I. All adjustment and acknowledgment permissions shall be password-level dependent.
- J. Replace existing controls, thermostats, actuators, etc., with new devices as necessary for incorporation into the new EMS control system.

3.2 ONE-TO-ONE HEAT PUMP SYSTEM

- A. The system shall operate under the factory control package complete with all safeties and alarms. EMS contractor shall wire all units and sensors.
- B. The EMS system shall interface with the factory control package to monitor status, all alarms and failures via BACnet.
- C. The condensing unit and indoor unit shall connect to the EMS via BACnet.
- D. The EMS system shall be able to interface with the factory controls to adjust set points, enable and disable the units, and provide occupied / unoccupied schedules. All write commands to be change of value only. All read commands to be no more than once a minute.
- E. Occupied: The fan coil supply fan shall run continuously and the system shall cycle the heating and cooling to maintain space temperature setpoint. In offices with fin radiation (hydronic or electric), the EMS shall enable and modulate the radiation control as a second stage to maintain its space temperature setting.
- F. Unoccupied: The fan coil supply fan shall be off. Where applicable, the EMS shall modulate the fin radiation control to maintain the reduced 62°F unoccupied

space temperature setpoint. In offices without fin radiation, if the space temperature drops below the night set back set point of 62°F, the unit shall start and run on full heating until the space temperature rises 2°F above the night set back set point. When the space temperature is satisfied the fan coil shall be off.

- G. The EMS shall provide the system with individual room set points. The EMS shall monitor the actual room temperatures through the packaged control system.
- H. The EMS shall open the motorized outside air damper during occupied mode and close the damper during unoccupied mode.
- I. Point List (Typical each space)
 - 1. Space temperature
 - 2. OA damper position command
 - 3. Fin Radiation (where applicable)
 - 4. All unit points available through the BACnet connection shall be visible and adjustable through the EMS to the full capabilities of the system.

3.3 STEAM CABINET HEATER

- A. When the vestibule temperature drops below the 60°F heating setpoint as sensed by a wall mounted sensor, the EMS shall modulate the steam control valve and cycle the unit heater fan as necessary to maintain its setpoint. The cabinet heater shall not operate when the outdoor air temperature is greater than 45°F.
- B. Point List
 - 1. Space temperature
 - 2. Outside air temperature
 - 3. Control valve position command
 - 4. Fan speed command

3.4 EXISTING STEAM RADIATOR

- A. When the vestibule temperature drops below the 60°F heating setpoint as sensed by a wall mounted sensor, the EMS shall modulate the steam control valve as necessary to maintain its setpoint. The radiator shall not operate when the outdoor air temperature is greater than 45°F.
- B. Point List
 - 1. Space temperature
 - 2. Outside air temperature

3. Control valve position command

3.5 HYDRONIC CABINET HEATER

A. When the vestibule temperature drops below the 60°F heating setpoint as sensed by a wall mounted sensor, the EMS shall modulate the hot water control valve and cycle the unit heater fan as necessary to maintain its setpoint. The cabinet heater shall not operate when the outdoor air temperature is greater than 45°F.

B. Point List

1. Space temperature
2. Outside air temperature
3. Control valve position command
4. Fan speed command

3.6 ELECTRIC CABINET HEATER

A. When the vestibule temperature drops below the 60°F heating setpoint as sensed by a wall mounted sensor, the EMS shall modulate the electric heat control and cycle the unit heater fan as necessary to maintain its setpoint. The cabinet heater shall not operate when the outdoor air temperature is greater than 45°F.

B. Point List

1. Space temperature
2. Outside air temperature
3. Electric heat command
4. Fan speed command

3.7 ENERGY RECOVERY VENTILATOR

A. The EMS shall schedule operation of the ERV. The supply and return/exhaust fans shall run continuously unless commanded off by the EMS. The EMS shall use current sensors to confirm the fans are in the commanded state (i.e., on or off) and generate an alarm if status deviates from the EMS start/stop command.

B. Occupied Mode: The EMS shall open the intake and exhaust shutoff dampers. After the dampers are open, the unit supply and return/exhaust fans shall run continuously unless manually or safety stopped.

C. Unoccupied Mode: The unit shall be off. All dampers shall be closed.

D. Above its setting, a differential pressure switch shall signal a dirty filter alarm

condition to the EMS.

E. Point List

1. Unit start/stop command
2. Shutoff damper position command
3. Supply fan status/alarm
4. Return fan status/alarm
5. Dirty filter alarm

3.8 VARIABLE REFRIGERANT FLOW SYSTEM

- A. The system shall operate under the factory control package complete with all safeties and alarms. EMS contractor shall wire all units, sensors and gateways.
- B. The EMS system shall interface with the VRF factory control package/gateway to monitor status, all alarms and failures via BACnet.
- C. The VRF Condensing Unit and all indoor units shall connect to the BACnet gateway.
- D. The EMS system shall be able to interface with the factory controls to adjust set points and enable and disable the units. All write commands to be change of value only. All read commands to be no more than once a minute.
- E. VRF Condensing Unit: The EMS shall enable the system operation during occupied periods and on a call for heating and cooling during unoccupied times.
- F. Indoor Fan Coil Units: Fan coil operation is controlled through factory VRF system controls. The EMS shall provide time clock scheduling.
 1. Occupied: The fan coil supply fan shall run continuously and the VRF system shall cycle the heating and cooling to maintain space temperature setpoint.
 2. Unoccupied: The fan coil supply fan shall be off. The VRF system shall cycle the supply fan to maintain individual room setback temperatures in the heating or cooling mode. When the space temperature is satisfied the fan coil shall be off.
 3. Any zone and system can be placed back into occupied mode (2-hour override) by pressing a button on the face of the room thermostat.
 4. The EMS shall provide the VRF system with individual room set points.

The EMS shall monitor the actual room temperatures through the VRF control system.

- G. The control valve(s) on the steam fin tube radiation shall be controlled through the VRF system control for FCU in the room with the valve. In offices with steam fin radiation, the control valve shall be modulated as a second stage of heating to maintain space temperature setting.

H. Point List

1. All fan coil and condensing unit points available through the VRF BACnet gateway shall be visible and adjustable through the EMS to the full capabilities of the system.
2. Fan coil supply air temperature
3. Steam fin tube radiation control valve position
4. Steam fin tube radiation control valve feedback

END OF SECTION 230993

SECTION 232000 – HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. All work under this title, on drawings or specified, is subject to the architectural general and special contract conditions for the entire project, and the contractor for this portion of the work is required to refer especially thereto, and to the architectural drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Common Work Results for HVAC: Section 230500
Cutting and Patching: Section 230503
Valves: Section 230523
Cleaning and Testing: 230593
Piping and Equipment Insulation: Section 230719
Direct Digital Control for HVAC: 230923

1.3 SUBMITTALS

- A. Product Data: Manufacturer's name and the schedule, type of class of all pipe and fittings.
 - 1. Where optional materials are specified in the "Pipe and Fitting Schedule", provide a pipe schedule to indicate the options selected; including piped systems, pipe material and break down of pipe sizes.
- B. Quality Control Submittals
 - 1. Installers Qualification Data
 - a. Welder Qualification Data: Copies of certification; including names and previous project experience of welders.
 - b. Brazer Qualification Date for Refrigerant Piping: State refrigerant piping brazing experience; including names and list of previous project experience of brazers.

1.4 QUALITY ASSURANCE

- A. Qualifications of Welding Procedures, Welders and Welding Operators: Comply with the following:
 - 1. Section IX ASME Boiler and Pressure Vessel Code, Part QW Welding.
 - 2. American Welding Society Standard AWS D10.9, AR-3
- B. Qualifications of Brazers: Comply with the following:
 - 1. Section IX ASME Boiler and Pressure Vessel Code, Part QB Brazing.
 - 2. Certification of brazing operator by recognized authorities which require a qualification test.
 - 3. Refrigerant Piping: The persons performing the brazing and their supervisors shall be personally experienced in refrigerant piping brazing procedures.

PART 2 – PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Standard Weight Schedule 40 or Extra Heavy Weight Schedule 80 Pipe, black or galvanized: ASTM A 53, ASTM A 106 or ASTM A 135.
- B. Flanges, Welding Neck Type, Same Pressure Rating as Adjoining Pipe: ASME B16.5.
- C. Welding Fittings, Carbon Steel:
 - 1. Butt Welding Type: ASME B16.9
 - a. Allied Piping Products Co., Inc.'s Branchlets, Type 1 or 2
 - b. Bonney Forge Corp's Weldolets
 - 2. Socket Welding Type: ASME B16.11
 - a. Allied Piping Products Co., Inc.'s Branchlets, Type 1 or 2
 - b. Bonney Forge Corp's Thredolets or Sockolets
- D. Compact Design Weld Fittings: Landish Co.'s LP, Nibco Inc's Husky, Taylor Forge Inc.'s Compact Line, Tube Turns Inc.'s Econo.
- E. Malleable Iron, Steam Pattern Threaded Fittings
 - 1. 150 lb. Class: ASME B16.3
 - 2. 300 lb. Class: ASME B16.3

F. Cast Iron Fittings

1. Drainage Pattern, Threaded: ASME B16.12
2. Steam Pattern, Threaded: ASME B16.4
 - a. Standard Weight: Class 125
 - b. Extra Heavy Weight: Class 250
3. Flanged Fittings and Threaded Flanges: ASME B16.1
 - a. Standard Weight: Class 125
 - b. Extra Heavy Weight: Class 250

G. Unions: Rated 250 psi at 210 degrees F; ASME B16.39

H. Unions: Rated 250 psi at 275 degrees F; ASME B16.39

I. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Use taper tapped threaded type in screwed pipe systems operating in excess of 15 psig.

J. Nipples: Same material and strength as adjoining pipe, except nipples having a length of less than one inch between threads shall be extra heavy.

2.2 COPPER AND BRASS PIPE, TUBING AND FITTINGS

A. Water Tube, Types K, L, and M: ASTM B 88

B. Wrot Copper Water Tube Fittings, Solder Joint: ASME B16.22

C. Refrigerant Tube, Dry Sealed, Soft Annealed: ASTM B 280

D. Flared Tube Fittings:

1. Water Tube Type: ASME B16.26
2. Automotive Tube Type: SAE J512
3. Refrigerant Tube Type: SAE J513

E. Flanges: Conform to the Standards for fittings used in systems.

1. Brazing Flanges: ASME B16.24, hubs modified for brazing ends.

F. Unions: Cast bronze, 150 lb. Class, bronze-to-bronze seats, threaded or solder joint.

2.3 JOINING AND SEALANT MATERIALS

A. Thread Sealant

1. Lake Chemical Co.'s, Slic-Tite.
2. Loctite Corp's pipe sealant with Teflon.

B. Solder: Solid wire type conforming to the following:

1. Lead-free tin-Silver solder (ASTM B 32 Alloy Grade Sn 96): All-State Welding Products Inc.'s 430, J. W. Harris Co. Inc.'s Stay-Brite or Engelhard Corp's Silvabrite.

C. Soldering Flux for Soldered Joints

1. Solder: All-State Welding Products Inc.'s Duzall; J. W. Harris Co. Inc.'s Stay-Clean; Engelhard Corp's General Purpose Liquid or Paste.

D. Brazing Alloys

1. AWS A5.8, Class BCuP-5, for brazing copper to brass, bronze, or copper; Englehard's Silvaloy 15; J. W. Harris Co.Inc.'s Stay-Silv 56; and Handy & Harman's Braze 560.
2. AWS A5.8, Class BAg-7, for brazing copper to steel or stainless steel; Englehard's Silvaloy 56-T; J. W. Harris Co.Inc.'s Safety-Silv 56; and Handy & Harman's Braze 560.

E. Brazing Flux: FS O-F-499, Type B; Handy & Harman's Handy Flux or J. W. Harris Co. Inc.'s Stay-Silv.

F. Electrodes and Welding Rods

1. Electrodes for use in Arc Welding: Heavily coated, not larger than 3/16 inch diameter exclusive of coating, unless otherwise acceptable.
2. Welding Rods: Free flowing when fused, so as to avoid excessive puddling.
3. Electrodes for Welding Stainless Steels: Coated and used with reverse polarity
4. Filler material shall conform to the appropriate AWS-ASTM specification.

G. Flange Gasket Material

1. For Use with Cold Water or Chilled Water: 1/16 inch thick rubber and chemical compatibility with the system fluid.
2. For Use with Hot Water, Air or Steam: Waterproofed non-asbestos mineral or ceramic fiber, or a combination of metal and waterproofed

non-asbestos mineral or ceramic fiber, designed for the temperature and pressures of the piping systems in which installed and chemical compatibility with the system fluid.

- H. Anti-Seize Lubricant: Bostick Inc.'s Never Seez or Dow Corning Corp's Molykote 1000.

2.5 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS

- A. Mechanical Modular Seals: Thunderline Corp's Link Seal wall and floor seals designed for the service of piping system in which installed.

2.6 DIELECTRIC CONNECTORS

- A. Brass nipples, couplings, fittings, valves or combinations of are not considered a dielectric connection and shall not be an acceptable assembly for such.
- B. Dielectric waterway fittings with an inert, non-corrosive thermoplastic lining (NSF/FDA listed). Manufacturer: Grinnell, GruvLok or Victaulic Co.
- C. Flange Electrical Insulation Kit: Consisting of dielectric sleeves and washers and dielectric gasket.
 - 1. Rated 250 psi at 210 degrees F.
 - 2. Rated 250 psi at 275 degrees F.
- D. Flange Unions: Rated 175 psi at 210 degrees F; ASTM B16.42 (iron) and ASTM B16.24 (bronze).

2.7 PIPE SLEEVES

- A. Type A: Schedule 40 steel pipe.
- B. Type B: No. 16 gauge galvanized sheet steel.
- C. Type C: Schedule 40 steel pipe and 1/4 inch steel collar continuously welded to pipe sleeve. Size steel collar as required to span a minimum of one cell or corrugation, on all sides of the rough opening thru the metal deck.
- D. Type D: No. 16 gauge galvanized sheet steel with 16 gauge sheet steel metal collar rigidly secured to sleeve. Size metal collar as required to span a minimum of one cell or corrugation on all sides of the rough opening thru the metal deck.

2.8 FLOOR, WALL AND CEILING PLATES

- A. Cast Brass: Polished chrome plated finish, with set screw.
 - 1. Solid Type: Models 5 and 5T by Pegasus Manufacturing Inc., Cheshire, CT; and Models 951 – 960 (inclusive) by Bridgeport Plumbing Products, Moultrie, GA.
 - 2. Split Type: Models 3 and 3T by Pegasus Manufacturing Inc., Cheshire, CT.
- B. Cast Iron: Solid type, unplated, with set screw. Model 395 by Grinnell Corp., Cranston, RI.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- A. The drawings show the general arrangement of pipe equipment but do not show all required fittings and offsets that may be required. Provide all necessary fittings, offsets and pipe runs based on field measurements.
- B. Provide dielectric connections whenever connecting dissimilar materials
- C. Install vertical piping plumb and piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide one inch minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope steam, condensate and drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- D. Install piping clear of door swings and above sash heads.
- E. Make allowances for expansion and contraction.
- F. Use fittings for offsets and direction changes, except for Type K soft temper water tube.
- G. Cut pipe and tubing ends square: ream before joining.
- H. Threading: Use American Standard taper pipe thread dies.
 - 1. Thread brass pipe with special brass threading dies.
- I. Make final connections to equipment with unions, flanges, or mechanical type joint couplings.

- J. Provide taps and install wells in piping for EMS/control system sensors and flow measurement devices.

3.2 STEAM PIPING SYSTEMS

- A. Install to permit complete drainage.
- B. Pitch
 - 1. Pitch horizontal steam mains, return mains and branches downward, 1/4 inch per 10 ft. in direction of flow.
 - 2. Pitch steam runouts and connections to risers upward, 3/16 inch per foot in direction of flow.
 - 3. Pitch return branches and runouts downward, 1/2 inch per 10 ft, indirection of flow.
- C. Use eccentric reducers in horizontal piping.
- D. Size short vertical supply and return connections, from horizontal runouts to radiator traps and valves, same size as trap or valve.
- E. Steam Trap piping: install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap wherever modulating control valves are used.

3.3 WATER AND PROPYLENE GLYCOL PIPING SYSTEMS

- A. Pitch
 - 1. Pitch horizontal piping 1/8 inch per 10 ft. in direction indicated on drawings. When direction of flow is not indicated, pitch supply piping up in direction of flow and return piping downward indirection of flow.
 - 2. Pitch single pipe systems up in direction of flow 1/8 inch per 10 ft.
- B. Air Vents: Install air vents at locations indicated on the drawings and at each high point in system. Use manually operated air vents, unless otherwise indicated.
- C. Drains
 - 1. Install piping to be completely drainable. Provide drains at low points, consisting of a 1/2 inch Drain Valve (Apollo #78-200) and at the following locations and equipment:

- a. In each section of piping separated by valves.
 - b. For each riser, where riser or runout to riser has a valve installed.
 - c. For each heating cooling unit, having valves in supply and return connections.
 - d. In low point of piping to each down fed convector or radiator.
- D. Runouts: Connect runouts to upfeed risers to top of mains and runouts to downfeed riser to bottom of mains.

3.4 PIPE JOINT MAKE-UP

- A. Threaded: Threads shall conform to ASME B1.20, joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- B. Soldered: Thoroughly clean tube end and inside of fitting with sandpaper or wire brush. Apply flux to the pre-cleaned surfaces. Install fitting, heat to soldering temperature, and join the metals with type solder specified. Remove residue.
- C. Flange:
 - 1. Install threaded companion flanges on steel pipe; flanges on galvanized pipe are not required to be galvanized.
 - 2. Provide a gasket for each joint.
 - a. Hot Water Pipe Gasket: Coat with a thin film of oil before making up joint.
 - b. Compressed, Control, and Instrument Air Pipe Gasket: Coat with a thin film of oil before making up joint.
 - 3. Coat bolt threads and nuts with anti-seize lubricant before making up joint
- D. Welded: Beveling, spacing and other details shall conform to ASME B31.9. See Welder's qualification requirements under "Quality Control Submittals" in Section 1.03, Submittals.
- E. Welded: Beveling, spacing and other details shall conform to ASME B31.1. See Welder's qualification requirements under "Quality Control Submittals" in Section 1.03, Submittals.
- F. Compact design weld fittings up to and including 12 inch in size may be used in low pressure steam and heating hot water piping systems.
- G. Braze Joint: Thoroughly clean tube end and inside of fitting with sandpaper or

wire brush. Apply flux to the pre-cleaned surfaces. Install fitting, heat to brazing temperature, and join the metals with brazing alloy. Remove residue.

H. Dissimilar Pipe Joints

1. Joining Dissimilar Threaded Piping: Make up connection with a threaded coupling or with companion flanges.
2. Joining Dissimilar Non-threaded Piping: Make up connection with adapters recommended by the manufacturers of the piping to be joined.
3. Joining Steel pipe, Brass or Copper Tubing: Make up joint with a dielectric connector.

3.5 PIPING PENETRATIONS

- A. Sleeve Schedule: Unless otherwise shown, comply with the following schedule for the type of sleeve to be used where piping penetrates wall, floor, or roof construction.

CONSTRUCTION	SLEEVE TYPE
1. Frame construction	None Required
2. Foundation walls	A*
3. Non-waterproof interior walls	B*
4. Non-waterproof interior floors on metal decks	D*
5. Non-waterproof interior floors not on metal decks	B*
6. Floors not on grade having a floor drain	A*
7. Floors over mechanical equipment, steam service, machine and boiler rooms.	A
8. Floors finished or to be finished with latex composition or terrazzo, and on metal decks.	D*
9. Floors finished or to be finished with latex composition or terrazzo and not on metal decks.	A
10. Earth supported concrete floors	None Required
11. Exterior concrete slabs on grade	A
12. Fixtures with floor outlet waste piping	None Required
13. Metal roof decks	C
14. Non-metal roof decks	A
15. Waterproof floor on metal decks	D
16. Waterproof floors not on metal decks	A
17. Waterproof walls	A

* - core drilling is permissible in lieu of sleeves where marked with asterisks.

B. Diameter of Sleeves and Core Drilled Holes

1. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
 2. Size holes thru exterior masonry walls or waterproofed walls above inside earth or finished floors, and exterior concrete slabs in accordance with the following:
 - b. Un-insulated (Bare) Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of pipe, unless otherwise specified.
 - c. Insulated Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of insulation, unless otherwise specified.
 - d. Mechanical Modular Seals: Size holes in accordance with the manufacturer's recommendations.
- C. Length of Sleeves (except as shown otherwise on Drawings)
1. Walls and Partitions: Equal in length to total finished thickness of wall or partition.
 2. Floors, Finished: Equal in length to total finished thickness of floor and extending 1/2 inch above the finished floor level, except as follows:
 - a. In furred spaces at exterior walls, extend sleeve one inch above the finished floor level.
 3. Exterior Concrete Slabs: Equal in length to total thickness of slab and extending 1/2 inch above the concrete slab.
 4. Roofs: Equal in length to the total thickness of roof construction, including insulation and roofing materials, and extending one inch above the finished roof level.
- D. Packing of Sleeves and Core Drilled Holes
1. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, smoke, fumes, and hot gasses as detailed in the UL Fire Resistance Directory, Warnock Hersey Certification Listings Book, or the Omega Point Laboratories Listings Directory. Where applicable design is not detailed in the Directories use forming materials and fill, void or cavity material to form appropriate through-penetration firestop in accordance with printed details and installation instructions from the Company producing the acceptable forming materials and fill, void or cavity materials.
 2. Firestop through-penetration of floors, walls, partitions, ceilings, and roof in accordance with the fire resistance rating assigned to the walls, partitions, floors, ceilings, and roofs on the Construction Work Drawings.

3. Pack sleeves in exterior masonry walls or waterproofed walls above inside earth or finished floors with oakum to within 1/2 inch of each wall face, and finish both sides with one-part, non-sag polysulfide base sealant: Pecora's Synthacalk GC-9, Products Research and Chemicals PRC Rubber Calk 7000, or Sonneborn's One Part Polysulfide Sealant. Optional use of Mechanical Modular Seals is recommended.
- E. Weld metal collars of sleeves to the upper surface of the metal deck. Seal voids under the metal collar as recommended by the manufacturer of the metal deck.

3.6 FLOOR, WALL AND CEILING PLATES

- A. Install plates for exposed un-insulated piping passing thru floors, walls, and exterior concrete slabs as follows:
 1. In Finished Spaces
 - a. Piping 4 Inch Size and Smaller: Solid or split, chrome plated cast brass.
 - b. Piping over 4 Inch Size: Split, chrome plated cast brass.
 2. Unfinished Spaces (including exterior concrete slabs): Solid, unplated cast iron.
 3. Fasten plates with set screws.
 4. Plates are not required in pipe shafts or furred spaces.

3.7 PIPING AND FITTING SCHEDULE

- A. Abbreviations: The following abbreviations are applicable to the Pipe and Fitting Schedule.

BS – black steel
CI – cast iron
MI – malleable iron
SE – screwed end
ST – steel
SW – standard weight
WE – weld weight
XH – extra heavy weight
- B. Where options are given, choose only one option for each piping service. Deviations from selected option will be allowed if reviewed with Engineer prior to installation.
- C. Schedule of Pipe and Fittings for the different piping services is as follows:

1. Steam Condensate Returns (LPR, MPR and Pumped Returns) 125 psig and less:
 - a. 2-1/2 inch and less: XH BS pipe, with SE & XH CI fittings, or WE & XH ST fittings.
 - b. 3 inch and above: XH BS pipe with WE & XH ST fittings.
2. Hot Water Supply and Return (HWS & HWR) 125 psig and less:
 - a. 2 inch and less: Type L hard temper copper tubing with wrought copper solder fittings and solder.
 - b. 2-1/2 inch size: SW BS pipe, with SE & SW CI fittings, or WE & SW ST fittings.
3. Refrigerants (RS, RL, HG & RD) 350 psig and less: Type L hard temper copper tubing with wrought copper fittings, and brazing alloy unless otherwise specified.
 - a. Soft annealed refrigerant tubing 3/4 inch od and smaller may be used for final connections within 24 inches of refrigerant equipment.
4. Steam (LPS & MPS) 125 psig and less:
 - a. 4 inch and less: SW BS pipe, with SE & SW CI fittings, or WE & SW ST fittings.
 - b. 5 inch and up: SW BS pipe with WE & SW ST fittings.
5. Condensate Drain Piping: Type M hard temper copper tubing with wrought copper solder fittings, and solder.

END OF SECTION 232000

SECTION 232006 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

HVAC Piping: Section 232000

1.3 SUBMITTALS

- A. Product Data: Catalog sheets, specifications, and installation instructions for each item specified.
- B. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Submit 2 copies to the Engineer incorporated within maintenance manuals, covering the installed products.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Taco
Bell & Gossett
Aurora Pumps

2.2 AIR VENTS

- A. Type A: Manual Coin Operated Vent; ITT Bell and Gossett Model 4V.
 - 1. Construction: Brass.
 - 2. Maximum Working Pressure: 150 psig.
 - 3. Maximum Operating Temperature: 212 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Manual Vent Valves: Install manual vent valves on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated.

END OF SECTION 232006

SECTION 232201 - STEAM SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

HVAC Piping: Section 232000

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, specifications and installation instructions for all items specified.

PART 2 PRODUCTS

2.1 STEAM VENTS

- A. Radiation Vents:
 - 1. Cast Iron Radiation: Hoffman Corp. No. 1A.
 - 2. Cast Iron Radiation (Vacuum Systems): Hoffman Corp No. 2A.
 - 3. Convector and Finned Type Radiation: Hoffman Corp. No. 1-B, for operating pressures up to 1-1/2 psi, and Nos. 71A, 71B and 71C for pressures up to 10 psi.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install specialties at locations indicated on drawings or specified.

END OF SECTION 232201

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SECTION 232202 - STEAM TRAPS

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 RELATED WORK SPECIFIED ELSEWHERE

HVAC Piping: Section 232000
Steam Specialties: Section 232201

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, specifications and installation instructions for all items specified.

PART 2 PRODUCTS

2.1 STEAM TRAPS - GENERAL

- A. Unless otherwise indicated, size thermostatic traps of capacity to continuously discharge 2-1/2 times normal condensate rate of particular equipment or apparatus being served.

2.2 THERMOSTATIC TRAPS

- A. Traps shall be designed for 125 psig steam pressure. Base maximum ratings on 1/2 psi differential through trap. All wearing parts shall be renewable.
- B. Balanced pressure thermostatic type, self-adjusting to all pressures within operating range. Body to be of forged red brass with male union inlet connection. Thermostatic element shall be of precision welded stainless steel construction, incorporating a hardened stainless steel valve head. Valve seats shall be stainless steel, and all internals, shall be replaceable without disturbing the piping connections.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install steam traps at locations indicated on drawings or specified. Install traps in accordance with manufacturer's instructions.

END OF SECTION 232202

SECTION 23 - METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section including but not limited to, Coordination Drawings in Division 1 Section "Project Management and Coordination".

1.2 RELATED WORK SPECIFIED ELSEWHERE

Common Work Results for HVAC: Section 230500
Duct Insulation: Section 230713
Ductwork Accessories: Section 233300
Diffusers, Registers, and Grilles: Section 233713
Balancing of Systems: Section 230594

1.3 REFERENCES

National Fire Protection Association (NFPA).
Sheet Metal and Air Conditioning Contractors National Association, Inc.
(SMACNA) Current published edition.
American Conference of Governmental Industrial Hygienists (ACGIH).

1.4 SUBMITTALS

- A. Fabrication Drawings: Submit 1/4" = 1'-0" (minimum) scaled reproducible drawings of metal ductwork and fittings including but not limited to: ductwork layout detailing, sizes, fabrication lengths, locations, elevations, slopes of horizontal runs. In addition indicate wall and floor penetrations, lighting, diffuser, building walls, steel locations with elevations and reflected ceilings (ceiling type and elevations noted). Show interface and space relationships between all items located above ceiling including but not limited to ductwork and equipment. (Submission of Engineers contract document Drawings will not be acceptable).
- B. Shop Drawings: Submit duct construction standards to include: schedule of all ducted air systems (indicating pressure class, materials, and seal class), sheet metal type, connections, reinforcement, turning vanes, fitting types, method of support, upper hanger attachment, ductliner specification.

1.5 QUALITY ASSURANCE

- A. SMACNA: Gages of materials, fabrication, reinforcement, sealing requirements, installation, and method of supporting ductwork shall be in accordance with the following SMACNA manuals, unless otherwise shown and/or as specified:
 - 1. HVAC Duct Construction Standards – Third Edition 2005.
- B. Conform to the applicable requirements of NFPA 90A, 90B and 96.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel: ASTM A653 lock forming quality - galvanizing: ASTM A924 coating designation G-90.

2.2 FABRICATION

- A. Fabricate all ductwork in accordance with this specification and SMACNA.
- B. Fabricate all ductwork from galvanized sheet metal.
- C. Round and flat oval ductwork shall be fabricated using spiral seam construction only. Snaplock seams are not allowed
- D. Rectangular and Round ductwork radius of all 90° through 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted. The radius of all 15° through 30° elbows shall be 1.0 times the elbow diameter. Mitered elbows shall be provided with turning vanes. Rectangular square throat 90° without turning vanes are not allowed.
- E. Dissimilar Metals: Separate dissimilar metals used for ductwork with 10 oz. canvas impregnated with zinc chromate. No separation is required between screws or rivets and the materials in which they are inserted.
- F. Sheet Metal:
 - 1. Minimum Rectangular Duct Construction to 2" W.G. unless noted otherwise on the contract drawings. For pressure class above 2" refer to SMACNA standards tables.
 - 2. All ductwork panels 18" and greater in width/height, 20 gage or less shall be cross broken or beaded. Internally lined ductwork is exempt from this requirement.
 - 3. Duct construction: reinforcement, gages and sealing on fittings, elbows and short lengths of ductwork shall be continuous throughout the system.

Duct Dimension longest side	*Duct Length	Minimum Duct Gage	Transverse Joint Connection / Reinforcement
Up to 16"	48"	24	S-Slip & Drives (Min. 24 ga.)(c)
17" to 28"	48"	24	Flanged (a)(c)
29" to 36"	48"	24	Flanged (a)(c)
37" to 48"	48"	22	Flanged (a)(b)(c)(e)
48" to 84"	48"	20	Flanged (a)(b)(c)(e)
84" to 96"	48"	18	Flanged (a)(b)(c)(e)
97" to 108"	48"	16	Flanged (a)(b)(d)(e)
107" & UP	Refer to SMACNA Tables for pressure class specified		

- a. Flanged ductwork joint connections shall be: SMACNA T-22, T-24, T-24a, T25a, T25b or slip-on flanges. (IE: Ductmate, Ward, Nexus, TDH and TDF installed per manufacturer's recommendations).
 - b. Intermediate reinforcement per SMACNA 2005
 - c. Longitudinal seam to be Pittsburgh, (snaplock seams are not allowed).
 - d. Longitudinal seam to be welded.
 - e. Refer to SMACNA reinforcement tables for additional intermediate required reinforcements.
4. Round Duct Construction - Minimum duct wall thickness unreinforced 2" W.G. positive/negative pressure.

Duct Dimension	Spiral Seam
6"	28
8"	28
10"	28
12"	28
14"	28
16"	26
18"	26
19" - 26"	26
27" - 36"	24
37" - 50"	22
51" - 60"	20
61" - 84"	18

Round ductwork shall be a manufactured duct system consisting of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer's instructions, will seal the duct joints without the use of duct sealer. Round ductwork shall be fabricated using spiral seam construction. (Snaplock seams are not allowed). Acceptable Manufacturers: Lindab (SPIROsafe); Semco (Custom Air); United McGill Corporation (Uni-Gasket).

- a. All fitting ends shall come factory equipped with a EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
- b. Fitting ends shall be calibrated to dimensional tolerance standard of the associated spiral duct.
- c. Fitting ends from 3" to 24" diameter shall have over edges for added strength and rigidity.
- d. Elbows from 3" to 12" diameter shall be 2-piece die stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing seam gorelock construction and internally sealed.
- e. The fittings shall be either spot-welded or button punched construction and shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted.
- f. Volume dampers as specified in 233300 - Ductwork Accessories.

5. Flat Oval Duct Construction – Minimum duct wall thickness unreinforced 2" W.G. positive/negative pressure.

Duct Width	Spiral Seam Duct Gage	Gage of Fitting
To 24"	24	20
25" to 36"	22	20
37" to 48"	22	18
49" to 60"	20	18
61" to 70"	20	16
71" to up	18	16

Flat Oval ductwork shall be fabricated using spiral seam construction. (Snaplock seams are not allowed). Acceptable Manufacturers: Lindab (SPIROsafe); Semco (Custom Air); United McGill Corporation (Uni-Gasket).

2.3 SUPPORT

A. Duct Hangers

1. Strap Hangers: As indicated below and/or same material as duct.
2. Rod Type Hangers: Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place. Unless stainless steel, galvanized or cadmium plated; shop coat with metal primer.

Maximum Half of Duct Perimeter	Strap @ 10 ft Spacing	Rod @ 10 ft Spacing	Strap @ 8 ft Spacing	Rod @ 8 ft Spacing	Strap @ 5 ft Spacing	Rod @ 5 ft Spacing	Strap @ 4 ft Spacing	Rod @ 4 ft Spacing
P/2 = 30"	1" x 22 ga	10 ga.	1" x 22 ga.	10 ga.	1" x 22 ga.	12 ga.	1" x 22 ga.	12 ga.
P/2 = 72"	1" x 18 ga	3/8"	1" x 20 ga.	1/4"	1" x 22 ga.	1/4"	1" x 22 ga.	1/4"
P/2 = 96"	1" x 16 ga	3/8"	1" x 18 ga	3/8"	1" x 20 ga	3/8"	1" x 22 ga	1/4"
P/2 = 120"	1 1/2" x 16 ga	1/2"	1" x 16 ga	3/8"	1" x 18 ga	3/8"	1" x 20 ga	1/4"
P/2 = 168"	1 1/2" x 16 ga	1/2"	1 1/2" x 16 ga	1/2"	1" x 16 ga	3/8"	1" x 18 ga.	3/8"
P/2 = 192"	-	1/2"	1 1/2" x 16 ga	1/2"	1" x 16 ga	3/8"	1" x 16 ga.	3/8"

B. Miscellaneous Fasteners and Upper Hanger Attachments:

1. Sheet Metal Screws, Machine Bolts and Nuts: Same material as duct, unless otherwise specified.

2. Concrete Inserts: Steel or malleable iron, galvanized; continuously slotted or individual inserts conforming with MSS SP-58, Types 18 & 19, Class A-B.
3. C Clamps: Fee & Mason Co.'s 255L with locking nut, and 255S with retaining strap.
4. Metal Deck Ceiling Bolts: B-Line Systems, Inc.'s Fig. B3019.
5. Welding Studs: Erico Fastening Systems, capacitor discharge, low carbon steel, copper flashed.
6. Structural (carbon) Steel Shapes and Steel Plates: ASTM A36, shop primed.
7. Stainless Steel Shapes and Plates: ASTM A276 and ASTM A666.
8. Machine Bolt Expansion Anchors:
 - a. Non-calking single unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 1.
 - b. Non-calking double unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 2.
 - c. Self - drilling type: FS FF - S - 325, Group III, Types 1 and 2

2.4 SEALANTS

- A. Acceptable Manufacturers: Duro Dyne Corp.; Foster Products Div., H.B. Fuller Co.; Hardcast Inc.; United Sheet Metal Div., United McGill Corp.
- B. U.L. Listed adhesives (liquid or mastic), scrim, or combinations thereof, as required for pressure class; suitable for system operating temperatures; compatible with media conveyed within, insulation (if any), and ambient conditions.
- C. Use of duct tape or silicone caulk for sealing seams and joints is not acceptable.

2.5 SEALING REQUIREMENTS

A. Sealing Requirements

1. Construct as a minimum to the following pressure and seal class.

System	Pressure Class	Seal Class
Supply, return and outside air duct	+2"	'A'
Exhaust and relief duct	-2"	'A'
Dishwasher exhaust	-4"	(a)
Fume hood exhaust	-4"	(b)

- (a) Duct shall be rectangular aluminum duct commercial grade with liquid tight welded seams.
- (b) Duct shall be 20 gauge AISI Type 316 stainless steel with liquid tight welded seams.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install ductwork to allow maximum headroom. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Coordinate with all trades proposed locations of ductwork prior to installation.
- B. Provide necessary transformation pieces and flexible fabric connections for ductwork connected to air handling equipment or air inlet and outlet devices.
- C. All transitions shall be made with less than 30° included angle.
- D. Provide safing to properly close off all openings in ductwork or sleeves in which any duct accessory is being installed as required by irregular openings or off-size equipment. All attempts shall be made to maximize the size of the accessory to the opening or duct.
- E. Ductwork installations exposed to view in finished spaces (refer to project documents) shall receive special attention by contractor. Care shall be taken to provide a neat uniform look, Round duct spiral seams shall align. Ductwork will be free of foreign matter (IE: construction debris, mud, dirt, excessive duct sealer, ETC.) Do not install damaged ductwork. Remove damaged ductwork at the direction of the engineer. Ductwork indicated to be painted (refer to project documents). Duct shall be wiped clean of grease, oils and any foreign materials not conducive to the adhering of paint.
- F. Coordinate the installation of all mechanical systems. Provide sufficient space around ductwork and equipment during installation to allow the proper application of insulation. As needed insulate ducts prior to erection in place when ducts are required to be installed proximate to walls, ceilings, equipment or other ductwork, which will not permit adequate space for the installation of insulation, at a later date. Exercise reasonable care in the installation of insulated ductwork, so that insulated surfaces are in perfect condition before and after installation.
- G. Ductwork seen behind registers, in other words; ductwork visible through a register (inside the duct) shall be painted using one coat of flat black metal paint

(after proper surface cleaning). Paint coverage shall be that no unpainted duct will be seen. This applies to all grilles, registers and diffusers.

3.2 SEALING SEAMS, JOINTS, AND PENETRATIONS

- A. Conform to SMACNA Seal Class A as a minimum regardless of pressure class except for continuously welded or soldered seams, where called for. Helical (spiral) lock seams are exempt from sealant requirements. All other duct surface connections made on the perimeter of the duct are deemed to be joints. Use of duct tape for sealing of seams and joints is not acceptable.
- B. Sealing requirements shall include, but not be limited to: transverse (girth) joints; longitudinal seams; duct wall penetrations; branch and sub-branch intersections; duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum and casing abutments to building structures.
- C. Pittsburgh sealing, sealant shall be applied in the Pittsburgh pocket prior to hammering. Sealant applied to the interior (back side of seam) of duct or to the exterior of seam is unacceptable.
- D. Ducts and plenums connecting to louvers (intake, exhaust, relief) shall be constructed with the bottom of duct/plenum sloped so that water drains back and out of the louver or to a central drain connection within the plenum. If a drain connection is provided, pipe to nearest floor drain. The duct or plenum shall be sealed as directed in 3.02, A (above). In addition, all seams of lower 6" (or greater, if higher water level potential exists) shall be soldered, or otherwise gasketed and sealed to create water-tight seams, joints and penetrations.

3.3 HANGERS FOR DUCTS

- A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:
 - 1. Rectangular ducts up to 42 inches wide, not having welded or soldered seams, and supported from overhead construction; extend strap hangers down over each side of the duct and turn under bottom of duct a minimum of 2 inches. Secure hanger to duct with 3 full thread sheet metal screws, one in the bottom and 2 in the side of the duct.
 - 2. Prime coat plain steel rods threaded at the site immediately after installation with metal primer.

3.4 UPPER HANGER ATTACHMENTS

- A. General: Secure upper hanger attachments to structural steel or steel bar joists wherever possible.
 - 1. Avoid damage to reinforcing members in concrete construction.
 - 2. Metallic fasteners installed with electrically operated or powder driven tools may be used as upper hanger attachments, in accordance with the SMACNA Manual.
- B. Prohibited Use
 - 1. Drive-on beam clamps (caddy clamp), flat bars or bent rods, as upper hanger attachments.
 - 2. Powder driven drive pins or expansion nails.
 - 3. Powder driven or welded studs to structural steel less than 3/16 inch thick.
 - 4. Loads in excess of 250 lbs from a single welded or powder driven stud.
 - 5. Powder driven fasteners in precast concrete.
 - 6. Do not use c-clamps to attach hangers in a shear type application. Use sheet metal screws, machine bolts and nuts or welds.
- C. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by ductwork support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of 5.
 - 1. Secure upper hanger attachments to steel bar joists at panel points of joists.
 - 2. Do not drill holes in main structural steel members.
- D. Attachment to Concrete Filled Steel Decks:
 - 1. Existing Construction: Install expansion shields.
 - 2. New Construction: Install concrete inserts or metal deck ceiling bolts.
 - 3. Do not attach hangers to decks less than 2-1/2 inches thick.

3.5 DUCT RISER SUPPORTS

- A. Support vertical round ducts by means of double-ended split steel pipe riser clamps bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.
- B. Unless otherwise specified or shown on the drawings, support vertical rectangular ducts by means of two steel angles, secured to duct and resting on floor slab or adjacent structural steel member, at every other floor through which the duct passes. Size supports as follows:

Max. Side Dimension (Inches)	Support Angle (Inches)	Secure to Duct with	Min. Bearing at Each End (Inches)
36	1 x 1 x c	Screws	2
48	1½ x 1½ x c	Bolts	3

3.6 OPENINGS THROUGH FIRE RATED WALLS & FLOORS NOT REQUIRING FIRE DAMPERS

- A. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
- B. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, smoke, fumes, and hot gasses as detailed in the UL Fire Resistance Directory, Warnock Hersey Certification Listings Book, or the Omega Point Laboratories Listings Directory. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form appropriate through-penetration firestop in accordance with printed details and installation instructions from the Company producing the approved forming materials and fill, void or cavity material.
- C. Fill the annular space between the duct and the rated construction (both sides of the rated construction) with a non-hardening, intumescent, UL listed firestop product; and in the absence of manufacturer's firestop system installation instructions or Engineer's recommendation, attach 1½" angles around the perimeter of all ducts (both sides of the rated construction).
- D. Firestop through-penetration of floors, walls, partitions, ceilings, and roofs in accordance with the fire resistance rating assigned to the walls, partitions, floors, ceilings, and roofs on the General and Mechanical Construction Drawings.

END OF SECTION 233113

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Metal Ductwork: Section 233113
Direct Digital Control System: Section 230923

1.3 REFERENCES

ACGIH: American Conference of Governmental Industrial Hygienists.
NFPA: National Fire Protection Association.
SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL: Underwriters Laboratories, Inc.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product. Submit SMACNA Figure Numbers for each shop fabricated item.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Unless otherwise shown or specified, comply with the applicable requirements of the following: **edit as required**
 - 1. SMACNA: Gages of materials, fabrication, sealing, and installation shall be in accordance with the HVAC Duct Construction Standards Manual.
 - 2. NFPA: Standards No.'s 90A, 90B, 91, 96, and 101.
 - 3. UL: Standards No. UL181, UL555, and UL555S. Use UL181 for flexible duct; UL555 for fire dampers; UL555S for combination fire/smoke damper

PART 2 - PRODUCTS

2.1 ROUND DUCT TAKE-OFFS / VOLUME DAMPERS

- A. Heavy Duty Bell Mouth Take-off: Air tight 24 ga. galvanized (G-90) gasketed bell mouthed, 22 ga. galvanized single blade damper, 3/8" solid bar shaft, indication / operation handle with locking hex nut and Tekline regulator. On insulated ducts, quadrant to be mounted on hat channel; channel height equal to exterior duct insulation thickness. Provide bearings at both ends of operating shaft. (Provide a 45 deg. take-off when the flange diameter of the bell mouth fitting exceeds the height of the duct main. Also provide a 45 deg. take-off were indicated on the drawings.) (Contractor fabricated dampers not acceptable).

2.2 DAMPERS

- A. Volume Control Dampers: Opposed blade type, frames of all welded construction utilizing channel iron members in galvanized steel ducts, extruded members in aluminum ducts and stainless steel in stainless steel ducts. Fabricate frames of 2 inch wide x 1/2 inch legs x 1/8 inch thick (minimum) members for dampers less than 10 sq ft in size and 2 inch wide x 1 inch leg x 1/8 inch thick (minimum) for larger sizes. Fabricate blades from No. 16 gage (minimum) metal, of same material as duct in which installed, with 3 horizontal grooves, 2 turned edges and trunnions mounted in brass sleeve or ball bearings. Space bearings on maximum 48 inch centers. Single blade dampers are unacceptable for ducts over 11 inches in height. Weld motor mounting bracket to damper frame, for pneumatic or electric motor operated dampers.
- B. Parallel Blade Dampers: Furnish with 2 inch wide x 1/2 inch leg x 1/8 inch thick metal frames of all welded construction, utilizing channel iron members in steel ducts and extruded aluminum members in aluminum ducts. Fabricate blades from No. 16 gage (minimum) metal, of same material as duct in which installed, with horizontal reinforcing grooves, 2 turned edges and trunnions mounted in bronze sleeve or ball bearings. Single blade dampers are unacceptable for ducts over 11 inches in height. Fabricate dampers of steel for installation in wall openings and for use on discharge side of exhaust fans. Weld motor mounting bracket to damper frame, for pneumatic or electric motor operated dampers. Shop coat raw ferrous parts of damper assemblies with corrosion resistant paint. Dampers used on outside air and exhaust applications shall have stainless steel edge seals and vinyl blade edge seals to for a maximum leakage rating of 20 cfm per sq.ft. of face area at 4" water gauge differential static pressure. Use when dampers are required to be installed in wall openings for outside air inlet or make-up air use and are interlocked with exhaust fans. Avoid product duplication when a temperature control section is included in specifications.
- C. Outside air, Relief air and Exhaust air: Dampers used on outside air and exhaust applications shall be insulated with thermally broken frame. Frame and blade edge seals shall be extruded silicone secured in an integral slot within the

aluminum frame/blade extrusions and shall be mechanically fastened. Dampers shall be AMCA rated for Leakage Class 1A at 1" water gauge differential static pressure. Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved; Tamco Series 9000 BF, or approved equal.

- D. Splitter Dampers: Fabricate dampers of same material as duct in which installed, with rolled or hemmed edges. Provide blades in ducts having a maximum side dimension under 24 inches of same gage as duct, and in ducts having a maximum side dimension 24 inches and over provide blades 2 gages heavier than duct.
- E. Fire Dampers; Static Systems:
 - 1. Provide UL 555 Classified and Labeled "Fire Resistance Rating 1-1/2 hr".
 - 2. Fire damper to be Type B, Blades out of the air stream.
 - 3. Frame to be one piece roll-formed 22Ga. galvanized steel.
 - 4. Blades to be 22 Ga. galvanized steel, curtain type.
 - 5. Provide damper with replaceable 165° F. fusible link.
 - 6. Provide with closure springs for both horizontal and vertically installed fire dampers
 - 7. Provide damper with the following options:
 - a. Factory supplied sleeves
 - 8. Design Manufacturer: Air Balance, Model 119B.
- F. Manual Damper Regulators:
 - 1. For Dampers Installed in Exposed, or Accessible Concealed Ductwork: Indicating quadrant with heavy metal handle and means for locking damper in all positions. On insulated ducts, quadrant to be mounted on hat channel; channel height equal to exterior duct insulation thickness. Provide bearings at both ends of operating shaft.
 - 2. For Dampers Installed in Inaccessible Concealed Ductwork: Concealed type with indicating regulator in cast metal box with cover plate. Furnish assembly complete with duct and bearing, adjustment coupling, damper extension rods and minimum of 2 keys or socket wrenches for each type of damper adjustment screw or device. On insulated ducts, quadrant to be mounted on hat channel; channel height equal to insulation thickness. Provide bearings at both ends of operating shaft
- G. Adjustable Vane Damper Assembly: Factory fabricated assemblies of same

material as ductwork in which installed. Design assembly so either half of each blade may be adjusted independently, with blades held in position by friction pins. Install damper unit in collar gasketed with heavy felt. Design assembly to facilitate positive volume control and uniform air distribution over entire outlet.

H. Combination Fire and Smoke Dampers

1. Air Balance Model FS2 250 or acceptable equal.
2. Construction Features
 - a. Fabricate in accord with National Fire Protection Association.
 - b. Labeled and inspected by Underwriters Laboratories, Inc.
 - c. Fire resistance rating of 1-1/2 hour rated per UL Standard 555
 - d. Leakage rated damper for use in smoke control systems, with a Class II/250 degree F per UL Standard 555S.
 - e. Blades-16 gauge channel.
 - f. 20 gauge galvanized steel sleeve (20" long).
 - g. Axles-1/2" square, plated solid steel stub.
 - h. Bearings-oil impregnated bronze.
 - i. Linkage-fixed type in air stream.
 - j. Stops-18 gauge galvanized steel.
 - k. Blade Edge Seals-silicone rubber.
 - l. 120 VAC Electric Actuator. Coordinate with existing fire alarm system.
 - m. Dual position indication switches.
 - n. Damper shall be Normally Closed.
3. Installation
 - a. Install at all locations shown on drawings.
 - b. Install access doors at all locations.

2.3 TURNING VANE ASSEMBLIES

- A. Fabricate vane assemblies of same material as ductwork in which installed. Provide individual hollow airfoil type vanes, rigidly connected to vane rails, with rails welded, screwed, or riveted to the ductwork.

2.4 FLEXIBLE CONNECTIONS - FABRIC

- A. Glass fabric coated with an inorganic elastomeric material, similar to Duro Dyne's Thermafab.

2.5 GASKET MATERIAL

- A. Registers, grilles and diffusers installed in exposed uninsulated ductwork: 1/4 inch thick felt or sponge rubber material, of width as required by the flange on

the particular device.

- B. Flanged joints in ducts: 1/8 inch thick reinforced inert plastic of the self-conforming type, of same width as flange.

2.6 FLEXIBLE DUCT

- A. Conform with NFPA 90A, and UL 181, Class I (minimum R-6):
 - 1. Un-insulated: Dual element construction consisting of a corrosion resistant metal support spiral, mechanically locked to reinforced coated glass fabric, conforming to NFPA Standard 90A.
 - 2. Pre-insulated: CertainTeed's Certaflex Punchline 25; Owens-Corning's INL-25; Wiremold WCK.
 - 3. Flexible ductwork installed in unconditioned spaces shall be minimum R-8. Refer to 230713 Duct insulation.

2.7 FLEXIBLE DUCT CLAMP

- A. Heavy duty Nylon Tie Anti-slip strap body tie, ribbed and stippled to prevent axial and lateral movement. Natural heat stabilized 6.6 nylon, high tensile strength which meets or exceeds industry and military standards (MIL-S-23190E). Temperature ratings 185 de. F max, -40 deg. F min. Positive grip locking anti-spring back tip: stainless steel (316) barb, infinitely adjustable strap. Shall be installed for a tight secure fit utilizing the manufacturer's installation tool. Manufacturer Panduit or equal.
- B. Stainless steel clamp: 9/16" wide band, plated 5/16" Hex head swivel action screw and bridge. Worm drive swivel action.

2.8 DUCT ACCESS DOORS

- A. Fabricate minimum 16 x 16 inch size, or duct size by 16" for ducts less than 16" in width, of same material and finish as duct unless otherwise shown or specified.
 - 1. For uninsulated duct designed for under 2 inches w.g.: Fabricate single panel door of same gage as duct, with all edges folded, size door to overlap opening perimeter by one inch.
 - 2. Provide door with a minimum of 4 sash locks, Ventfabrics, Inc. Ventlock No. 260 or Duro Dyne Corp. Code No. SP Series. Sash Locks shall be galvanized, cadmium plated, or aluminized steel or cast aluminum.
 - 3. For insulated duct and duct designed for 2 inches w.g. and over: Fabricate hollow metal doors in accordance with the SMACNA Manual. Fill void in doors for insulated duct with thermally equivalent insulation.

4. Provide doors with a 3/4 inch wide gasket and duct sealer around all 4 sides of duct opening at joint of access door frame and duct.

2.9 PLENUM ACCESS DOORS

- A. Fabricate minimum 24" x 36" inch size, of same material and finish as plenum unless otherwise shown. Fabricate doors in accordance with the SMACNA Manual.
- B. Door design shall be minimum rating of 4.5" w.g.: Fabricate door frame of .060 aluminum extrusion with 1-1/4" wide flange, double layer door panel of 18 ga. galvanized steel (G-90) with .060 aluminum extrusion frame, fill void in door with 1" thick fiberglass insulation.
- C. Provide door with continuous type aluminum hinge.
- D. Provide 2 locking door latches: Ventfabrics, Inc., Ventlock No. 260 or Duro Dyne Corp. Code No. SP Series.
- E. Provide door with a 3/4 inch wide foam rubber gasket.
- F. Provide view port: minimum 8x8 plexiglass window.

2.10 DUCT MOUNTED SMOKE AND CARBON MONOXIDE DETECTORS

- A. Furnished by electrical contractor. Installed by HVAC contractor. Wired by electrical contractor. Coordinate locations with electrical contractor.

2.11 ROOF CURB FOR DUCT PENETRATIONS NOT DIRECTLY CONNECTED TO FANS

- A. Factory fabricated, double shell, aluminum, a minimum of 2" thick, insulated with mineral wool, or thermally equivalent insulation as approved. Fabricate curbs from minimum No. 18 gage aluminum, properly braced and stiffened to form a rigid weatherproof unit. Curbs shall be a minimum of 12" high.

PART 3 – EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

- B. Install manual volume control dampers in all branch ducts and take-offs.
- B. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.2 TURNING VANES

- A. Install turning vanes in all rectangular, round and oval square duct construction with 90° elbows and elsewhere as indicated. Small vanes shall be installed in ducts 29" wide and smaller; larger vanes shall be installed in ducts 30" and larger.

3.3 FLEXIBLE FABRIC CONNECTORS (Installation)

- A. Make ductwork connections to air handling equipment with flexible fabric connectors. Install connectors with sufficient slack to prevent vibration transmission.
- B. Free Fabric Length: Install fabric connectors a minimum of 3 inches in length for ducts having a maximum diameter of 18 inches, or maximum side dimension of 30 inches, and a minimum of 5 inches in length for duct diameters over 18 inches or side dimensions over 30 inches.
- C. Secure fabric connectors to fans, casings and ducts as follows:
 - 1. Secure round connectors with No. 12 USS gage x 1 inch wide galvanized steel draw bands. Secure bands with bolts and nuts.
 - 2. Secure rectangular connectors with 1 inch x 1/8 inch thick flat galvanized steel bars, with screws or bolts on maximum 8 inch centers, or with approved sheet metal slip joints. Tightly crimp fabric into sheet metal joint and secure complete joint with sheet metal screws on maximum 6 inch centers.
- D. Fabric connectors may be factory pre-fabricated pre-assembled units, with minimum No. 24 USS gage metal edges, secured to fabric with double lock seams.
- E. Do not paint fabric connectors.

3.4 ACCESS DOORS

- A. Install gasketed access doors in ductwork for each motor operated damper, manually operated volume control device, smoke damper, fire damper, smoke detector, in duct heating coil and at all locations where operating parts of any kind are installed and require access and elsewhere as indicated. Access doors

are not required, where a manually operated damper has an exposed damper regulator, with an indicating quadrant.

- B. Install access door accessible to service personnel, providing clear use of the door entire opening, positioned in the ductwork providing servicing of the entire fire damper with-in the duct. Access door shall not be blocked by any obstructions (i.e.: pipe, conduit, other ductwork, etc).
- C. Access doors provided to access fire dampers and smoke dampers shall be labeled with 1/2" tall letters (black paint) "FIRE DAMPER", "SMOKE DAMPER" OR "FIRE/SMOKE DAMPER". In situations where text does not fit use FD, SD or FD/SD.

3.5 CONCEALED DAMPER REGULATORS

- A. Imbed box in, and secure to back-up construction in ceiling or wall, so cover plate is flush with final surface.

3.6 FLEXIBLE DUCT

- A. Install flexible duct as per manufacturer's instructions. Provide intermediate support along horizontal runs to avoid excessive sagging. Maximum extended length to be 36".
- B. Secure each end of inner fabric of flexible duct to diffuser and ductwork with a flexible duct clamp. Secure each end of outer jacket with a flexible duct clamp independently of inner duct clamp. Nylon or Stainless steel.

3.7 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.8 ADJUSTING AND CLEANING

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
- B. Label access doors after cleaning in accordance with Division-23 section "Mechanical Identification" and with NFPA 90A.
- C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing".

- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.9 EXTRA STOCK

- A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 233300

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SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Metal Ductwork: Section 233113

1.3 REFERENCES

NFPA: National Fire Protection Association.

SMACNA: Sheet Metal and Air Conditioning (Sub)Contractors National Association, Inc.

UL: Underwriters Laboratories, Inc.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product. Submit SMACNA Figure Numbers for each shop fabricated item.
- B. Provide a room schedule, to include: listing of all rooms (room name or number), equipment identification tag, CFM, face and inlet neck size, quantity required and corresponding manufacturers' model number.
- C. Samples: When requested by the Engineer, submit one complete unit for each type of proposed air inlet and outlet device. Approved samples will be delivered to the job site for installation.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Unless otherwise shown or specified, comply with the applicable requirements of the following:
 - a. SMACNA: Gages of materials, fabrication, sealing, and installation shall be in accordance with the HVAC Duct Construction Standards Manual.

- b. NFPA: Standards No.'s 90A, 90B, 91, 96, and 101.
- c. UL: Standards No. UL555.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Nailor Industries, Inc.
Carnes
Price

2.2 GRILLES AND REGISTERS

- A. Provide all Registers with damper assembly: Opposed multi-blade type, consisting of frame, blades, and key operated movement of the locking type, with operator projecting through frame. Furnish operators which are removable or permanently secured in place, as directed. Fabricate damper assemblies for use with aluminum or stainless steel register faces of aluminum with an etched or acrylic coated finish, and for use with factory painted register faces, factory finished in baked white enamel, or equivalent finish as approved by the Engineer.
- B. Return / Exhaust Grille:
 - 1. Louvered Face: Provide grille of the size and mounting type indicated on the plans and outlet schedule. Grille shall have roll-formed corrosion-resistant steel fixed blades. Frame shall be constructed from roll-formed corrosion-resistant steel and have reinforced mitered corners. Finish shall be baked enamel color selected by architect.
 - 2. Eggcrate: Provide grille of the size and mounting type indicated on the plans and outlet schedule. Grille shall have a 1/2" x 1/2" x 1/2" aluminum grid core and extruded aluminum frame that has reinforced mitered corners. Finish shall be baked enamel color selected by architect.

2.3 AIR DIFFUSERS

- A. Ceiling Diffusers:
 - 1. Stamped Square: Provide supply diffuser of the size and mounting type indicated on the plans and outlet schedule. Diffuser shall be manufactured from corrosion-resistant steel and have four concentric cones in all sizes, except the 20" x 20" module size which will consist of three cones. The inner cone assembly shall be removable using a spring

clip arrangement that permits quick, easy installation and removal. The diffuser shall have a removable plug for screwdriver adjustment of the damper without removing the inner core. Finish shall be baked enamel color selected by architect.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Unless otherwise shown or specified, install the Work of this section in accordance with the manufacturer's printed installation instructions and the SMACNA Manual.
- B. Ductwork seen behind registers, in other words; ductwork visible through a register (inside the duct) shall be painted using one coat of flat black metal paint (after proper surface cleaning). Paint coverage shall be that no unpainted duct will be seen. This applies to all grilles, registers and diffusers.

END OF SECTION 233713

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SECTION 233723 - ROOF MOUNTED AIR INLETS AND OUTLETS

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 RELATED WORK SPECIFIED ELSEWHERE

Metal Ductwork: Section 233113
Duct Accessories: Section 233300

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, standard schematic drawings, specifications and installation instructions for each size unit and curb.

PART 2 - PRODUCTS

2.1 OUTSIDE AIR INTAKES AND RELIEF AIR VENTS

- A. Design: Outside air intakes and relief air vents shall be of the same style as the power roof ventilators installed on the same roof, or required to be installed on the same roof, unless otherwise indicated on drawings or specified. Units shall be of sectional construction consisting of a base section and a top section or cover. Top section shall be hinged or easily removable for access to inside of base section and curb.
- B. Fabrication: Fabricate intakes and relief vents from a heavy gage aluminum, properly braced and stiffened to form a rigid stormproof unit, which will withstand a minimum horizontal pressure of 30 lbs. per square foot of projected area. Provide 1/2" insulation on underside of hood to prevent condensation. Fabricate all hinges, friction catches and other fastening devices from corrosion resistant material, as approved. Intakes and relief openings shall be provided with aluminum (insect-bird) screens. Basic housing materials for the different styles of intakes and vents are as follows:
 - 1. Standard (Low contour rectangular shaped): Sheet aluminum.
 - 2. Dome Shaped: Spun aluminum top section (dome) and anodized sheet

aluminum.

2.2 ROOF CURBS

- A. Fabrication: Factory fabricated, double shell aluminum, a minimum of 2" thick, insulated with mineral wool, or thermally equivalent insulation as approved. Fabricate curbs from minimum No. 18 gage aluminum, properly braced and stiffened to form a rigid weatherproof unit.
- B. Manufacture: Curbs shall be the product of the ventilator manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Preliminary Work: Deliver curbs to Construction (Sub)Contractor for installation. Coordinate with the Construction (Sub)Contractor in the locating and sizing of all roof openings required.
- B. Install roof curbs in complete accordance with the manufacturers' printed installation instructions.
- C. Secure air intakes and relief air vents to roof curbs, with approved fastening devices.

END OF SECTION 233723

SECTION 233730 - LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

Metal Ductwork: Section 233113
Direct Digital Control System: Section 230923

1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication details of Louvers.
- B. Product Data: Manufacturer's catalog sheets, performance charts, test data, specifications and installation instructions for each.

1.4 GENERAL

- A. AMCA Test Standard: For louvers with specified air performance, water penetration, and air leakage ratings, provide units whose ratings have been determined in compliance with AMCA Standard 511.
- B. Structural Performance: Design, engineer, fabricate and install units capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of components, metal fatigue or noise from louver blade rattle or flutter and permanent damage to fasteners or anchors.
 - 1. Wind Load: Uniform pressure of 30 lbf per sq. ft. acting inward and outward.
 - 2. Normal thermal movement from ambient temperature change (range) of 100° F (55.5° C) and its effect on metal surfaces due to both solar heat gain and night time sky heat loss.
- C. Field Measurements: Verify size, location and placement of louver units prior to fabrication.

- D. Preassemble units in shop to greatest extent possible.

PART 2 - PRODUCTS

2.1 LOUVERS

- A. American Warming and Ventilating, LE-23; or acceptable equal.
- B. Kynar Finish: Color selection by Architect. Colors to be selected from Manufacturer's full range of color selections.
- C. Materials:
1. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T52, 0.081" minimum section.
 2. Fasteners: Noncorrosive and compatible with materials joined. For aluminum, use aluminum or 300 series stainless-steel fasteners.
- D. Fabrication, General: Fabricate louvers and accessories to comply with requirements indicated for design (blade angle, blade profile, blade spacing), metal type and form, sizes, depth, arrangement and metal thicknesses indicated or required for performance and use intended.
1. Fabricate frames, including sills, to suit adjacent construction, with mullions at spacing indicated but no further apart than recommended by manufacturer.
 2. Join frame members to one another and to blades with fillet welds, concealed from view; or mechanical fasteners; or both, as standard with louver manufacturer.
- E. Horizontal drainable fixed blade louvers with gutters in front edges of blades and channels in jambs and mullions for drainage, complying with the following requirements.
1. Performance rated as follows for 48 inch square unit and marked with the AMCA Certified Ratings Seal:
 - a. Louver Free Area: Not less than 8.9 sq. ft.
 - b. Static Pressure Loss: Not more than 0.13 inch water gage at an airflow at 1009 fpm free area velocity.
 - c. Water Penetration: 0.01 oz. per sq. ft. of free area at an airflow of 1009 fpm free area when tested for 15 minutes.
- F. Louver Screens: On interior face of exterior louvers, provide louver screens

complying with the following requirements:

1. Frames: Of same metal and finish as louvers to which frames are attached, and of the rewirable type with driven spline or insert for securing screen mesh.
2. Louver Screening for Aluminum Louvers: 1/2" square mesh bird screening, 0.063 inch diameter aluminum wire.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Deliver louvers to Construction (Sub)Contractor for installation.

END OF SECTION 233730

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SECTION 235413 - ELECTRIC CABINET HEATERS

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 RELATED WORK SPECIFIED ELSEWHERE

Wiring of Mechanical Equipment: Section 230512
Motor Controls: Section 230512
Direct Digital Control System: Section 230923

1.3 REFERENCES

AMCA and ARI standards.
UL listed.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, standard schematic drawings, specifications and installation instruction for each size unit and curb.
- B. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Submit 2 copies to the Engineer, incorporated within maintenance manuals, covering the installed products.

1.5 MAINTENANCE

- A. Spare Parts: Two complete sets of filters for each heater; packaged and labeled as to their usage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Q'Mark
Markel

Chromalox

2.2 ELECTRIC HEATERS

- A. Cabinet: Heavy duty cold-rolled steel. The heater front covers shall be securely attached to the cabinet with a maximum of two slotted head style spring latches and easily removable for access to elements, filters and control panel.
- B. Heating Elements: Warranted for five years and shall be of non-glowing design consisting of 80/20 NiChi resistance wire enclosed in a steel sheath to which steel plate fins are brazed. The heating element shall be located directly in front of the blower discharge air for uniform heating.
- C. Safety Thermal Cutouts: Built into the system to automatically shut off heater in event of overheating due to any cause. The safety cutouts shall directly interrupt power to the elements and not depend on relays to interrupt the power.
- D. Motor and Blower Assembly: Direct drive and resiliently mounted on a rigid heavy duty frame for quiet operation and long life. The motor(s) shall be two speed 1/8 H.P. with automatic reset overload protection. The motor shall be vented and mounted in the air stream to provide maximum cooling of the motor. Motor fuse protection shall be provided to meet UL, cUL and NEC requirements. The blower(s) shall be forward curved, double inlet, centrifugal type with discharge directly on the full length of the elements to provide uniform discharge air temperatures.
- E. Air Filter: Located ahead of the motor and blower assembly to ensure clean air circulation. The filter shall filter both the returning room or the outside air if the optional outside air damper assembly is provided. Filter shall be easily removed for changing or cleaning by removing the front panel and pulling on the filter. A disposable filter is standard.
- F. Front Cover Interlock: Heater shall be provided with an electrical interlock to shut down the heater when the front cover is opened to provide safety to the maintenance personnel during filter cleaning (replacement) or other maintenance.
- G. Fan Delay Control: Fan control shall delay start up of the fan motor(s) until the heating elements have warmed up. It shall maintain motor operation after heating elements have been de-energized to dissipate residual heat.
- H. Heat Selection and Fan Speed: Two fan speeds and high-low heat ranges shall be selectable by means of a single rocker switch located behind the front cover.

- I. Accessories: Provide integral disconnect switch, control transformer and contactors installed inside heater cabinet and remote wall mounted low voltage thermostat.
- J. Factory Finish: Cabinet shall be finished in polyester powder coating. Colors shall be as selected by the Architect/Engineer from the heater manufacturer's standard color charts.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install heaters at locations indicated on drawings.
 - 1. Vertical Mounted Type: Secure to wall construction as required and directed.
 - 2. Horizontal Mounted Type: Secure to overhead construction with rod type hangers, in number and size as recommended by the heater manufacturer.

3.2 CONTROL

- A. Install wall mounted low voltage thermostat as indicated on drawings or as directed.

END OF SECTION 235413

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SECTION 236000 - REFRIGERATION

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 RELATED WORK SPECIFIED ELSEWHERE

HVAC Piping: Section 232000
Pipe Hangers and Supports: Section 230529
Piping Insulation: Section 230719
Wiring of Mechanical Equipment: Section 230512
Cleaning and Testing: Section 230593

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, performance charts, standard schematic drawings, specifications and installation instructions for all items specified.
- B. Quality Control Submittals:
 - 1. Test Reports: Provide system test reports in accordance with the Section entitled "Cleaning and Testing". Frame one set of test report sheets under glass and mount in a conspicuous manner on Mechanical Equipment Room wall. Mount a second and third set on stiff cardboard and bind into the maintenance manuals.
- C. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Submit 2 copies to the Engineer, incorporated within maintenance manuals, covering the installed products.

1.4 SCOPE

- A. Provide a complete refrigeration piping system from the direct expansion cooling coil at the furnace to the remote air-cooled condensing unit.
- B. Provide a complete approved refrigerant piping system from the manufacturer. The refrigerant piping system shall include pipe sizes, arrangements and accessories.

1.5 QUALITY ASSURANCE

- A. Qualifications: Installation of refrigerating equipment shall be performed by skilled mechanics regularly engaged in refrigeration Work.

- B. Regulatory Requirements: Refrigeration equipment and accessories shall be designed, constructed, tested, installed and shall operate in accordance with the following:
1. ASHRAE 15 Safety Code for mechanical refrigeration.
 2. Applicable equipment standards of ARI.
 3. NFPA.
 4. All local Refrigeration, Fire and Safety Codes.
 5. All electrical components shall be UL listed.

1.6 MAINTENANCE

- A. Extra Materials:
1. Furnish one spare thermostatic element assembly for each size expansion valve installed.
 2. When thermal expansion valves are installed of a type that must be removed from the line for servicing, furnish a complete spare valve for each size installed.
 3. Furnish all special tools required to maintain the refrigeration equipment.

PART 2 PRODUCTS

2.1 REFRIGERANTS

- A. Coordinate refrigerant type with equipment being provided.

2.2 FILTER DRIERS

- A. Refrigeration systems less than 10 tons:
1. Sealed Type: Furnish on tubing sizes 3/8" to 1-1/8" O.D.
 2. Working Pressures: UL listed for 500 psig with a pressure drop not to exceed 2 psig.
 3. Filter-drier shall be specifically designed for refrigerant installed. Desiccants shall have moisture and acid removing qualities as well as the ability to entrap fine particles and prevent wax build-up.
- B. Refrigeration systems 10 tons and larger:
1. Refillable Type: Furnish on tubing sizes 3/8" to 1-1/8" O.D.
 2. Working Pressures: UL listed for 500 psig with a pressure drop not to exceed 2 psig.
 3. Filter-drier shall be specifically designed for refrigerant installed. Desiccants shall have moisture and acid removing qualities as well as the ability to entrap fine particles and prevent wax build-up
- C. Heat Pump systems:
1. Sealed Type: Bi-Directional. Furnish on tubing sizes 3/8" to 1-1/8" O.D.
 2. Working Pressures: UL listed for 500 psig with a pressure drop not to exceed 2 psig.
 3. Filter-drier shall be specifically designed for refrigerant installed.

Desiccants shall have moisture and acid removing qualities as well as the ability to entrap fine particles and prevent wax build-up for heating and cooling cycles.

4. Internal check valve.

2.3 MOISTURE - LIQUID INDICATOR

- A. Type: Provide a visual check type designed to indicate moisture in the system by changing color and shortage of refrigerant or restriction in the liquid line by the presence of bubbles.
- B. Fabrication:
 1. Body: Copper plated steel or non-porous forged brass with solder connections.
 2. Sight Glass: Sealed and covered with a suitable removable cap to keep sight glass free of grease or dirt.
- C. Moisture Content: System moisture content shall be in accordance with the manufacturer's color calibration chart, based on the type of refrigerant and the operating liquid line temperature.

2.4 THERMAL EXPANSION VALVES

- A. Type: Provide valves designed to meter the flow of refrigerant. Selection of type and size, most suitable for the particular refrigerant and application, shall be made in accordance with the manufacturer's recommendations.

2.5 SOLENOID VALVES

- A. Type: Provide valves of the normally closed type with manual lifting stem. When used in liquid refrigerant lines, pressure drop through valves shall not exceed 3 psig. Selection of type and size, most suitable for the particular application shall be made in accordance with the manufacturer's recommendations.

PART 3 EXECUTION

3.1 APPLICATION

- A. Install refrigeration equipment and accessories, as indicated on the drawings and as specified, in complete accordance with the manufacturer's instructions.

3.2 SELF CONTAINED CONDENSING UNITS

- A. Install units on reinforced concrete pads.
- B. Pipe the condensing unit into the direct expansion coil with solenoid valves, refrigerant shutoff valves, sight-glass, expansion valve and all other specialties complete as required and as indicated on drawings.

3.3 REFRIGERATION ACCESSORIES

- A. Filter Driers: Provide a filter drier in the liquid line of each system.

- B. Moisture-Liquid Indicators: Provide an indicator at point in refrigerant piping, where the refrigerant state at the entrance of the thermal expansion valve may be checked, and at condensing units.
- C. Thermal Expansion Valves:
 - 1. Provide valves as close as possible to the evaporator inlets, with the feeler bulb clamped to the suction line at a location where the bulb temperature will reflect the same temperature as the evaporator during the "off" cycle.
 - 2. When indicated, install an externally equalized thermal expansion valve and all equalizing connections, as required by the equipment installed.
 - 3. When indicated, install a pressure limit type thermal expansion valve to prevent refrigerant feed into the cooling coil, until the pressure has been reduced to the safe operating limits of the compressor motor, during subsequent pull down after defrosting and other warm pull-down conditions.

3.4 FIELD QUALITY CONTROL

- A. Refrigeration Systems - Dehydration, Charging and Testing: Refer to Section entitled "Cleaning and Testing".

END OF SECTION 236000

SECTION 237220 – AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

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 RELATED WORK SPECIFIED ELSEWHERE

Wiring of Mechanical Equipment: Section 230511

Motor Controls: Section 230512

Direct Digital Control System: Section 230923

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, performance charts, standard schematic drawings, specifications and installation instructions for each size and type fan.
- B. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Submit 2 copies to the Engineer, incorporated within maintenance manuals, covering the installed products.

1.4 MAINTENANCE

- B. Extra Materials: Provide one complete spare set of air filters with each unit, in addition to the installed operating set. Suitably box and label spare filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with this specifications, manufacturers include, but are not limited to:
 - RenewAire

2.2 PERFORMANCE

- A. Energy Transfer: The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
- B. Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.
- C. Continuous Ventilation: Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters, or defrost cycles under normal operating conditions.
- D. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix. No metal separators or metal core material shall be acceptable.
- E. Laminar Flow: Airflow through the ERV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

2.3 CONSTRUCTION

- A. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
- B. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
- C. The unit case shall be constructed of 24-gauge steel, with lapped corners and zinc-plated screw fasteners. The case shall be finished with textured, powder coat paint.
- D. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets.
- E. Case walls and doors shall be fully insulated with 1 inch, expanded polystyrene foam insulation faced with a cleanable foil face on all exposed surfaces.

- F. The ERV cores shall be protected by a MERV-8 rated, spun polyester, disposable filter in both airstreams.
- G. The unit shall have a line-cord power connection and be supplied with an internal 24 VAC transformer and relay.
- H. Standby power draw shall not exceed 1 Watt for the unit along with an optional automatic control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Locate unit per plans. Provide service clearances as indicated on the plans.
- C. Use integral mounting flange and hanging bar system to mount the unit per manufacturer's installations to a structurally suitable surface. The units may be mounted in any orientation.
- D. Provide flexible duct connections at unit duct flanges.

END OF SECTION 237200

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SECTION 238127 – DUCTLESS SPLIT AIR CONDITIONING SYSTEM

PART 1 – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Wiring of Mechanical Equipment: Section 230889.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, brochures, performance charts, standard schematic drawings, specifications and installation instructions for each air conditioner specified.
- B. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Deliver 2 copies to the Engineer, incorporated within the maintenance manual, covering equipment supplied.

1.3 STANDARDS & CERTIFICATIONS

- A. System shall have published performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI Standard 210/240 certified product directory.
- B. System components shall comply with Underwriters Laboratories (UL) 1995 Heating and Cooling Equipment Standard for Safety and bear the Electrical Testing Laboratories (ETL) label.

PART 2 – PRODUCTS

2.1 ACCEPTABLE UNIT MANUFACTURER

Trane / Mitsubishi
Hitachi
Lennox
Samsung

2.2 INDOOR CASSETTE UNIT

- A. General

1. Compact 360° cassette indoor unit shall be completely factory assembled and tested. The unit shall include all wiring, piping, electronic expansion valve, and printed circuit boards necessary for operation.
2. The unit shall automatically restart after power failure.
3. The unit shall have a pre-heat function to delay fan operation until the indoor coil has reached a field-adjustable temperature.
4. The air distribution panel shall allow for complete 360° airflow for more uniform temperature distribution. A four-way air distribution shall not be acceptable.
5. The indoor unit shall include motor-driven louvers and shall support automatic vertical swing functionality.
6. The unit shall include a factory-provided LED readout display and infrared receiver panel. The LED display shall indicate the current operational set point of the indoor unit.
7. The unit shall have a factory-installed 4-relay dry contact board for contact closure depending on indoor unit operation: cooling thermal on, heating thermal on, fan on, and auxiliary/alternative heat control. The dry contact board shall be capable of providing a dry contact output for interlock settings with Lennox VRF indoor units.

B. Unit Cabinet

1. The indoor unit shall be constructed of galvanized steel.
2. The unit must be capable of installing in a 24 inch by 24 inch lay-in ceiling grid.
3. The unit shall be low profile, with a maximum height of 8-1/4 inches.

C. Fan

1. The indoor unit shall be supplied with a turbo fan with backward curved blades.
2. The indoor unit shall use
3. The fan motor shall be a direct-drive motor with a high efficiency DC motor capable of operating at low, medium, and high fan speed. There shall be an optional super high fan speed available by re-tapping the fan motor in the field.
4. The fan motor shall be thermally protected.

D. Coil

1. The indoor unit coil shall be rifled copper tubing with hydrophilic coated aluminum fins, with 16 fins per inch.
2. The coil shall have a design pressure of 250 – 650 psi.
3. The coil connections to the main refrigerant network shall be flare fittings.

E. Filter

1. The unit shall include an easily removable, washable mesh filter.

F. Electrical

1. The power supply to the indoor unit shall be 208-230 volts, 1 phase, 60 Hz +/- 10%.
2. The control wiring to the indoor unit shall be 18-gauge, 3-core, stranded, and shielded. Unshielded communication wire shall not be accepted. Control wire shielding shall be grounded in accordance with manufacturer's recommendations.

G. Condensate Pump

1. The unit shall include an integral condensate lift pump capable of 27-1/2 inches of lift.

2.3 OUTDOOR UNIT

A. General:

1. Both refrigerant lines from the outdoor unit to indoor unit shall be insulated.
2. The outdoor unit shall have an accumulator.
3. The outdoor unit shall auto-restart after power loss.
4. The outdoor unit shall have a high pressure safety switch, fuse, over-current protection, over-voltage protection, temperature limit protection logic, compressor overload sensing, and crank case heater.
5. The outdoor unit shall be capable of operating in outside ambient temperatures between 14°F to 115°F in cooling mode and 75°F to -13°F in heating mode.
6. The control circuit between the indoor units, and the outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable.
7. The outdoor unit shall supply power to indoor unit via 14 AWG X 3 power wire

8. The outdoor unit shall have a removable EEPROM that stores system programming information, unit name, and other data.
9. The outdoor unit shall have a snow accumulation prevention option setting to prevent snow drifting against an idle outdoor unit.
10. The outdoor unit shall have a night time quiet mode option to reduce operating sound during the night (18,000 btu/h models: automatic activation, 24,000 btu/h and larger models: automatic or manual activation with dry contact signal).

B. Unit Cabinet

1. The chassis shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.
2. Pipe connections at the outdoor unit shall be made inside the unit chassis. Refrigerant pipes can exit through the front, side, rear, or bottom sides of the outdoor unit.

C. Fan

1. Outdoor units shall be furnished with one (1) direct drive, variable speed propeller type fan.
2. All fan motors shall be BLDC type.
3. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
4. The fan motor shall be mounted for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.

D. Refrigerant

1. The condensing unit shall require R410A refrigerant.
2. The condensing unit come charged for system line set lengths up to 25 feet. Additional refrigerant is required if the system line set length is over 25 feet.
3. The condensing unit shall contain a single EEV (electronic expansion valve) to control refrigerant flow to the indoor unit.

E. Coil

1. The outdoor coil shall be aluminum, flat fin, micro channel.
2. The coil shall be protected with an integral guard.
3. Refrigerant flow from the outdoor unit shall be controlled by means of a capacity modulation capable, inverter driven, twin BLDC rotary compressor.

F. Compressor

1. The compressor shall be an inverter driven, DC voltage, twin BLDC rotary compressor made by Samsung.
2. A crankcase heating device shall be factory mounted in/on the compressor.
3. The outdoor unit compressor shall have a variable modulation technology to modulate capacity.
4. The compressor shall be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical

1. The outdoor unit electrical power shall be 208/230 volts, 1 phase, and 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, 16 AWG, shielded, two-core cable to provide total integration of the system.
5. The outdoor unit shall provide power to the indoor unit with 14 AWG X 3 power wire (2 X high voltage wires, 1 X ground). The power wire shall be run from the condensing unit to indoor unit.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install units of type as indicated, in complete accordance with the manufacturer's instructions and as indicated.
- B. Support:
 - 1. Support ceiling hung units from the overhead construction by means of rod type hangers, unless otherwise indicated. Support wall mounted units from structure as recommended by manufacturer.
- C. Install refrigeration piping in accordance with manufacturer's recommendations. Check piping for leaks and correct any deficiencies.

END OF SECTION 238127

SECTION 238129 - VARIABLE REFRIGERANT FLOW SYSTEM

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 RELATED WORK SPECIFIED ELSEWHERE

- A. Wiring of Mechanical Equipment: Section 230511
- B. Metal Ductwork: Section 233133
- C. Direct Digital Controls: Section 230923

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, brochures, performance charts, standard schematic drawings, specifications and installation instructions for each air conditioner specified.
- B. Pipe sizing with shop drawings by equipment manufacture's selection software.
- C. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Deliver 2 copies to the Engineer, incorporated within the maintenance manual, covering equipment supplied.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Fan ratings shall be approved by AMCA. In lieu of an AMCA approved fan rating for the fan section of the unit, the Engineer may accept the fan manufacturer's certified rating, provided this fan manufacturer has AMCA approved ratings on his regularly manufactured centrifugal fans.

PART 2 - PRODUCTS

2.1 ACCEPTABLE UNIT MANUFACTURER

Mitsubishi Electric; or approved equal.

2.2 HEAT RECOVERY OUTDOOR UNITS

- A. General: The VRF system shall consist of outdoor unit, indoor units, and DDC (Direct Digital Controls). The outdoor units shall be equipped with multiple circuit boards that interface to the controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped, wired and run tested at the factory.
1. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s).
 2. Outdoor unit shall have a sound rating no higher than 58 dB(A) individually or 61 dB(A) twinned.
 3. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
 4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
 5. Outdoor unit shall be able to connect to up to 48 indoor units depending upon model.
 6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
 7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
 8. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
 9. The outdoor unit shall have rated performance of heating operation at -13°F ambient temperatures and cooling mode down to 23°F ambient temperatures, without additional low ambient controls. The unit shall maintain 100% heat output at 0°F without a supplemental heat source or a second compressor to boost low ambient heating performance.
 10. Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.
 11. Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
 12. Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.
 13. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
 14. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard

protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

15. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.

B. Heat Interchanger circuit.

1. The outdoor unit shall contain a heat interchanger circuit for sub-cooling liquid prior to entering the outdoor coil during the heating mode.
2. The interchanger shall be of a copper tube within a tube construction.
3. The interchanger circuit refrigerant flow shall be controlled by an electronic expansion valve.

C. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

D. Fan:

1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

E. Refrigerant

1. R410A refrigerant shall be required for TURY outdoor unit systems.
2. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

F. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

G. Panel Heater:

1. Each outdoor unit module shall be equipped with a panel heater. Panel heater shall activate only when compressor is operating in heating mode at an outdoor ambient temperature of 39F or below. If an alternate manufacturer is selected, any additional material, cost, and labor to meet panel heater condition and performance shall be incurred by the contractor.

H. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

I. Controls:

1. The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system

J. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz.

2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.3 BRANCH BOX (BB) CONTROLLERS

- A. General: The BB (Branch Box) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit performance. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The BC Controller shall be suitable for use in plenums in accordance with UL1995 ed 4.
- B. BC Unit Cabinet:
 1. The casing shall be fabricated of galvanized steel.
 2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
 3. The unit shall house two tube-in-tube heat exchangers.
- C. Refrigerant
 1. R410A refrigerant shall be required.
- D. Refrigerant Branches
 1. All BC Controller refrigerant pipe connections shall be brazed or flared.
- E. Refrigerant valves:
 1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 2. Each branch shall have multiple two-position valves to control refrigerant flow.

3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
 4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- F. Future Use
1. Each VRF system shall include at least one (1) unused branches or branch devices for future use. Branches shall be fully installed & wired in central location with capped service shutoff valve & service port.
- G. Integral Drain Pan:
1. An Integral resin drain pan and drain shall be provided
- H. Electrical:
1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz.
 2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
 3. The BC Controller shall be controlled by integral microprocessors
 4. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 INDOOR UNITS - CEILING-CONCEALED DUCTED

- A. General: The unit shall be a ceiling-concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The unit shall support individual control using DDC controllers. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.
- B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
1. The unit shall be, ceiling-concealed, ducted.
 2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

D. Fan:

1. Units shall have external static pressure settings from 0.14 to 0.60 in. WG.
2. The indoor unit fan shall be an assembly with one or two fan(s) direct driven by a single motor.
3. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
4. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function
5. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter:

1. Return air shall be filtered by means of a standard factory installed return air filter.
2. Optional return filter box (rear or bottom placement) with high-efficiency filter shall be available for all indoor units.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The condensate shall be gravity drained from the fan coil.
7. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls:

1. This unit shall use controls provided by the unit manufacturer to perform functions necessary to operate the system. Refer to controls section of this specification for details on controllers.

2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.5 INDOOR UNITS – WALL MOUNTED

- A. General: The indoor unit shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The unit shall support individual control using DDC controllers.
- B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
 1. All casings, regardless of model size, shall have the same white finish
 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
 3. There shall be a separate back plate which secures the unit firmly to the wall.
- D. Fan:
 1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
 2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

H. Controls:

1. This unit shall use controls provided by the unit manufacturer to perform functions necessary to operate the system. Refer to controls section of this specification for details on controllers and other control options.
2. The unit shall be able to control external backup heat.
3. The unit shall have a factory built in receiver for wireless remote control
4. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
6. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
7. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.6 INDOOR UNIT - 4-WAY CEILING RECESSED CASSETTE

A. General:

1. Four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Branch ducting shall be allowed from cabinet.
4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space.

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

9. If specified, the grille shall have an optional i-see sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
7. Both refrigerant lines to the PLFY indoor units shall be insulated in accordance with the installation manual.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. This unit shall use controls provided by Mitsubishi Electric Trane to perform functions necessary to operate the system.
2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.7 CONTROLS

A. Overview: The CITY MULTI Controls Network (CMCN) shall be capable of supporting remote controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet®.

B. Electrical Characteristics

1. General: The controls shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.
2. Wiring:
 - a. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
 - b. Control wiring for the remote controllers shall be from the remote controller (receiver) to the first associated indoor unit then to the remaining associated indoor units in a daisy chain configuration.
 - c. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.
3. Wiring type:
 - a. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire.
 - b. Network wiring shall be CAT-5 with RJ-45 connection.

C. Controls Network

1. The Controls Network shall consist of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using BACnet® interfaces.

D. Remote Controllers

1. The Backlit Simple Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). The controller shall be compact in

size, approximately 3" x 5" and have limited user functionality. The controller shall support temperature display selection of Fahrenheit or Celsius. The controller shall allow the user to change on/off, mode (cool, heat, dry, setback and fan), temperature setting, and fan speed setting and airflow direction. The controller shall be able to limit the set temperature range. The controller shall be capable of night setback control with upper and lower set temperature settings. The room temperature shall be sensed at either the controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The controller shall display a four-digit error code in the event of system abnormality/error.

2. The controller shall require no addressing. The controller shall connect using two-wire, stranded, non-polar control wire to connection terminal on the indoor unit. The controller shall require cross-over wiring for grouping across indoor units.

E. Centralized Controller (Web-enabled)

1. The Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple outdoor units with the use of three (3) expansion controllers. The controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the controller shall include on/off, operation mode selection (cool, heat, auto, dry, setback and fan), temperature setting, fan speed setting, and airflow direction setting. It shall be able to enable or disable operation of local remote controllers. The controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.
2. All controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main interface.

3. The controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.
4. Standard software functions shall be available so that the building manager can securely log into each controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics.

F. System Integration

1. The controls shall be capable of supporting integration with Building Management Systems (BMS).
2. The BACnet® interface shall be compliant with BACnet® Protocol (ANSI/ASHRAE 135-2004) and be Certified by the (BTL) BACnet® Testing Laboratories. The BACnet® interface shall support BACnet Broadcast Management (BBMD). The BACnet® interface shall support a maximum of 50 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.

G. Power Supply

1. The power supply shall supply 24VDC for the centralized controller and 30VDC voltage for the central control transmission.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units of type as indicated, in complete accordance with the manufacturer's instructions and as indicated.
- B. Refrigerant pipe sizing shall be in accordance with manufactures sizing software. Contractor shall provide shop drawings to equipment manufacturer for sizing. Shop drawings shall show length of piping and anticipated fittings to allow selection software to size piping. No piping shall be provided until sizing is complete.
- C. Support:
 1. Support ceiling hung units from the overhead construction by means of rod type hangers, unless otherwise indicated. Support wall mounted units from structure as recommended by manufacturer.

2. Provide miscellaneous support steel as required for proper support of condensing units.
- D. Install refrigeration piping in accordance with manufacturer's recommendations. Check piping for leaks and correct any deficiencies.

END OF SECTION 238129

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SECTION 238237 - FINNED TUBE RADIATION

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 RELATED WORK SPECIFIED ELSEWHERE

HVAC Piping: Section 232000
Valves: Section 230523

1.3 SUBMITTALS

- A. Schedule: Itemize pipe or tube size and material, fin size and material, fin thickness, fin spacing per linear foot, actual finned length of each element, number of rows of element and rating in Btuh per linear foot of finned element (single or double row) and location of installation (room or space number).
- B. Product Data: Manufacturer's catalog sheets, brochures, performance charts, specifications and installation instructions for each item specified.
- C. Quality Control Submittals:
 - 1. IBR Directory: Submit one current copy.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Ratings of radiation shall be IBR approved, and listed in the current IBR Directory.

1.5 PRODUCT DELIVERY

- A. Deliver radiation equipment in shipping containers, properly labeled as to type, size and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS/COMPANIES

Sterling
Trane
Vulcan
Rittling

2.2 FINNED TUBE RADIATION

A. Heating Elements:

1. Steel Type: Fabricated from threaded seamless steel tube, or Schedule 40 ASTM black steel pipe, with steel fins securely bonded to same by expansion of the tube or pipe, or equivalent method as approved by the Engineer. Furnish steel tube with a minimum wall thickness of 0.123 inch for 1 inch tube and 0.135 inch for 2 inch tube. Fins shall be a minimum of 0.024 inch thick, of size and in number per linear foot of element, as indicated.
2. Non-Ferrous Type: Fabricated from 3/4 inch, 1 inch or 1-1/4 inch seamless copper tubing, with aluminum fins securely bonded to the tubing by expansion of the tubing, or equivalent method as approved by the Owner. Rate tubing for 150 psi working pressure. Fins shall be minimum of 0.015 inch thick, of size and in number per linear foot of element as indicated. Provide fins with integral finned collar and a stamped pattern for strength and rigidity. Furnish tube ends suitable for use with solder fittings.
3. Heating elements utilizing welding, brazing or soldering for its fabrication are not acceptable.

B. Wall Mounting Strips: Channel type, roll form strip fabricated from a minimum of No. 20 USS gage sheet steel, of color and finish to match enclosure. Furnish strip with a continuous channel running the full length of the strip, so as to allow the enclosure panel to rigidly lock into place and the bottom into the enclosure brackets.

C. Enclosure Brackets and Cradles: Fabricate from a minimum of No. 14 USS gage sheet steel die formed, rigidized, with mounting holes for sliding chair and installed on 2'-0" centers. Secure brackets to the top mounting strips. Support heating elements on maximum 4'-0" centers, by means of chair type cradles and provide for adjustment of pitch and alignment of elements. Fabricate cradle from a minimum of No. 16 gage steel, designed to slide free and easily on support arms which shall be attached to the brackets. Rod, scissors type or wire support hangers are not acceptable. When additional piping is to be installed, provide special hangers furnished by the radiator manufacturer or a qualified pipe hanger

manufacturer as approved.

D. Enclosures, Standard Type:

1. Sloping Top Design: Fabricated from a minimum of No. 16 USS gage sheet steel with an integral pencil-proof top outlet louver, firmly supported at top by a continuous channel type wall mounting strip and at the bottom by enclosure brackets. Provide gusset plates extending from the top and front of the enclosure to the wall, so as to ensure retention of the enclosure shape during shipment and after installation. Offset enclosure at one end, to allow for joining without external joiner strips. Furnish die-formed end panels with rounded edges.

E. Enclosure Accessories: Furnish end caps, corner pieces, wall-to-wall trim strips, pilaster covers, column covers, etc., of the same manufacturer.

F. Finish (Enclosures and Accessories): Factory applied prime coat followed by baked enamel on visible surfaces. Color as indicated or as selected by the Architect/Engineer from the manufacturer's standard colors.

2.3 MISCELLANEOUS MATERIALS

A. Calk for Mounting Strip: As recommended by manufacturer, color to match mounting strips.

B. Fasteners:

1. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips Series S-14.
2. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hiti's HDI Series, or Red Head/Phillips J Series.
3. Hollow Wall, Hex Head, and Drive Fasteners: Molly Fastener Group, Molly Division Headquarters, 504 Mt. Laurel Ave., Temple, PA 19560.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions unless shown or specified otherwise.
- B. Secure radiation enclosure wall mounting strips and brackets to masonry wall construction with fasteners on maximum 2'-0" centers.

C. Finned Type Radiations:

1. Install radiation with a 4 inch clearance between finished floor and the bottom of the radiator enclosure, unless otherwise indicated. Make selection resulting in the left and right end panels of each individual wall-to-wall, wall-to-column or column- to-column installation being the same length and the intermediate panels, between the left and right end panels, being the longer panels. Intermediate panels shall be the same length except where access panels are required.
2. Continuously calk, between the mounting strip and the wall surface.

END OF SECTION 238237

SECTION 238239 - UNIT HEATERS

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 RELATED WORK SPECIFIED ELSEWHERE

Wiring of Mechanical Equipment: Section 230511

Motor Controls: Section 230512

Direct Digital Control System: Section 230923

1.3 SUBMITTALS

- A. Product Data: Catalog cuts, specifications, installation and maintenance instructions for each type of heater specified.
- B. Schedule: List manufacturer, unit type, model number, and performance data for each unit heater.
- C. Contract Closeout Submittals:
 - 1. Operation and Maintenance Data: Submit 2 copies to the Engineer, incorporated within maintenance manuals, covering the installed products.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Unit heaters shall be UL listed.

PART 2 PRODUCTS

2.1 CABINET TYPE UNIT HEATERS

- A. Unit Casing: Constructed of steel sheet formed, reinforced and braced for rigidity, with stamped grilles.
 - 1. Materials:

- a. Galvanized Steel Sheet: ASTM A 526, phosphatized; with G90 hot-dip process zinc coating complying with ASTM A 525.
 - b. Cold-Rolled Steel Sheet: ASTM A 366, cleaned, degreased and phosphatized.
 2. Factory Finish: Minimum 2 coat baked enamel finish on exposed surfaces, color as directed.
 3. Insulation: Insulate interior surfaces of casing panels with 1/2 inch glass fiber meeting NFPA 90A requirements.
 4. Vertical Units: Minimum 16 gage construction with removable front panel.
 5. Horizontal Units: Minimum 18 gage construction with hinged bottom panel.
- B. Heating Coils: Seamless copper tubing with mechanically bonded aluminum fins, designed for 150 psig working pressure for hot water and steam applications, and factory tested at 250 psig air pressure under water.
- C. Fan Assembly: Blow thru design.
1. Fans: Forward curved centrifugal type, double width, statically and dynamically balanced, and directly connected to electric motor.
 2. Motors: Minimum three (3) speed, single phase EC motors.
- D. Filter Section: Built-in filter frame mounted at air inlet with 2 sets of disposable air filters.
1. Vertical Units: Filters removable without removing front panel for cabinet type units.
 2. Horizontal Units: Filters removed by pivoting hinged bottom panel.
- E. Control: Refer to

2.2 KICK-SPACE HEATERS

- A. Kickspace heater designed for installation under cabinets with discharge air grille and speed switch accessible from front of unit through grille. Unit shall be U.L. approved. Provide unit with self-contained aquastat to prevent operation with water temperature below 140°F.
- B. Heating Coils: Mechanically bonded aluminum fins with seamless copper tubing for hot water with factory mounted air vent.
- C. Fan Assembly:

1. Fan: Multiple blade centrifugal type, statically and dynamically balanced, and directly connected to electric motor.
2. Motor: Two-speed, triple ball bearing, single phase, totally enclosed electric motor of the permanent split capacitor or shaded pole type, with resilient mounting, terminal box for wiring connections, built-in overload protection, and ball or sleeve bearings with oilers, or permanently lubricated bearings.

D. Control: Refer to Section 230923.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this section in accordance with the manufacturers printed installation instructions, unless otherwise specified.

END OF SECTION 238239

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SECTION 238333 - ELECTRIC FIN RADIANT HEATERS

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 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, brochures, performance charts, specifications and installation instructions for each item specified.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: UL listed.

PART 2 PRODUCTS

2.1 GENERAL

- A. Acceptable Standard
 - 1. Qmark or equal.
- B. 125 & 250 watts per lineal foot, active length as indicated on drawings.
- C. Decorative 5.5" high wall convectors and pedestal mounted convector.

2.2 FEATURES

- A. Thermal limit switch with linear type (full length) sensing bulb to provide constant protection against overheating.
- B. Remote low voltage thermostat with control transformer.
- C. End caps.
- D. Enclosures, Security Type-Perforated: Completely enclosed wrap-around design, of 14 USS gage steel; sloping top with 1/8 inch diameter holes in the inlet and

outlet air openings. Secure enclosure to a continuous top and bottom support strip. Fasten enclosure to bottom support strip with vandal resistant sheet metal screw 1'-0" on centers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions unless indicated otherwise (power wiring by electrical (sub)contractor).
- B. Secure radiation enclosure wall mounting strips and brackets to masonry wall construction with fasteners on maximum 2'-0" centers.
- C. Finned Type Radiations:
 - 1. Install radiation with a 4 inch clearance between finished floor and the bottom of the radiator enclosure, unless otherwise indicated.
 - 2. Continuously caulk between the mounting strip and the wall surface.

END OF SECTION 238333

SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Basic administrative and procedural requirements, and general requirements for electrical products and installation, applicable to all Division 26 work.
- B. This Section also applies to all Division 27, 28 work. Wherever reference is made to "Division 26" (Electrical) such reference shall also mean Division 27 (Communications) and Division 28 (Electronic Safety and Security).

1.2 RELATED DOCUMENTS

- A. Bidding Requirements, Contract Forms, and Conditions of the Contract (General and Supplementary Conditions) and the Drawings apply to all work of Division 26.
- B. Comply with Division 1 - General Requirements.
- C. All work under this Division shall be in accordance with the Contract Documents, as defined in the General Conditions.

1.3 SCOPE OF WORK

- A. General: Provide all supervision, labor, fees, licenses, materials, incidentals, tools, equipment, transportation, hoisting, scaffolding, and services necessary for and incidental to completion of all electrical work as indicated on the Drawings, specified herein, and/or indicated elsewhere in the Contract Documents.
- B. Lifts: Provide Genie and/or atrium lifts as necessary to perform required work (e.g. in gymnasiums and rooms with high ceilings).
- C. Start-up and Testing: Perform start-up and testing for each electrical item and system, to provide fully operable systems.

1.4 CONFLICTS

- A. General: If, in the interpretation of contract documents, it appears that the drawings and specifications are not in agreement, the Contractor is to contact the Engineer. The Engineer shall be the final authority. Addenda supersede the provisions which they amend.
- B. Approval: In the absence of a written clarification by the engineer, install work in accordance with the more stringent and/or costly condition. Contractor assumes full

responsibility for any and all items furnished and installed without the written approval by the Architect/Engineer. Under no circumstances will a change order be accepted for work installed that was not approved by the Architect/Engineer.

1.5 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1. EC: The Contractor performing the Electrical work.
2. MC: The Contractor performing the Heating, Ventilating, Air Conditioning, and Mechanical work.
3. PC: The Contractor performing the Plumbing work.
4. GC: The Contractor performing the General building work.
5. CM: The Construction Manager.

B. References to the above designations are not intended to define contracts and/or subcontracts but only as reference to where items are shown on drawings or described in specifications.

C. Definitions:

1. Concealed: Embedded in masonry or other construction, installed behind wall furring, within partitions or hung ceilings (permanent or removable), in trenches, or in crawl spaces.
2. Exposed: Not installed underground or concealed.
3. Noted: As indicated on the drawings and/or specified.
4. Indicated or Shown: As indicated or shown on the Drawings.
5. Wiring: Conduits, fittings, wire, junction and outlet boxes, switches, cutouts, and receptacles and items necessary or required in connection with or relating thereto.
6. Provide: Furnish and install.

1.6 DRAWINGS AND SPECIFICATIONS

- A. Drawing Use: The drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or details. Install work substantially as indicated. Exact equipment locations and raceway routing, etc. shall be governed by actual field conditions and/or instructions of the Architect/Engineer.
- B. Interpretation: If, in the interpretation of contract documents, it appears that the drawings and/or specifications are not in agreement, the one requiring the greater quantity or superior quality shall prevail, as decided by the Architect/Engineer. Addenda supersede the provisions which they amend.
- C. Complete Systems: Provide all materials as required for complete systems, including all parts and labor obviously or reasonably incidental to a complete installation, whether

specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be fully operational, prior to Owner's acceptance.

- D. Wiring: The wiring specified and/or shown on the Drawings is for complete and workable systems. Any deviations from the wiring shown due to a particular manufacturer's or subcontractor's requirements shall be made at no cost to either the Contract or the Owner.
- E. Review and Inclusions: After review of the drawings and specifications, the EC shall be completely familiar with the function of all items included, and his bid shall reflect the inclusion of all hangers, racks, inserts, etc., necessary for complete and operable systems. The EC shall provide offsets, fittings and accessories as may be required to meet project field conditions. The EC shall make all changes in equipment, locations, etc., to accommodate the work and to avoid obstacles at no increase in remuneration.
- F. Field Dimensions: All dimensions which relate to the building shall be taken as construction progresses. All errors incurred as a result of the EC's failure to check or verify dimensions, measurements, etc., shall be corrected at the EC's expense.
- G. Work of Other Trades: The Contractor shall review the contract documents for the work of other trades, informing the Architect/Engineer of any conditions which obstruct, interfere with, or in any way prevent him from completing his work in a first class manner.

1.7 MISCELLANEOUS REQUIREMENTS

- A. Control Power: Provide 120-volt power to control panels provided by other trades, as required.
- B. Minor Items: Work also includes minor items which may not be shown or mentioned, but are necessary for a complete, working electrical installation.
- C. Temporary Power and Lighting: Provide as required for construction operations and for ample job site security, and per Division 1.
- D. Tests and Adjustments: The EC shall furnish testing equipment, instruments and personnel to perform all test procedures and adjustments required by the National Electrical Code, the utility company and the authority having jurisdiction to establish proper performance and installation of electrical equipment and materials.

1.8 CODES AND STANDARDS

- A. Requirements of Regulatory Agencies: Applicable local, state and national laws, statutes, building codes and regulations as well as utility company requirements shall govern the complete installation.
- B. Permits: Obtain permits and pay all fees required by the local inspecting authority.

- C. Reference Standards: The latest applicable recognized editions of the following codes, standards, and specifications shall be considered minimum requirements:

1. (ADA) Americans with Disabilities Act
2. (ANSI) American National Standards Institute
3. (ASTM) American Society for Testing and Materials
4. (CBM) Certified Ballast Manufacturers
5. (ETL) Electrical Testing Laboratories
6. (IBC) International Building Code
7. (ICEA) Insulated Cable Engineers Association
8. (IEBC) International Existing Building Code
9. (IECC) International Energy Conservation Code
10. (IEEE) Inst. of Electrical and Electronics Engineers
11. (IES) Illuminating Engineering Society
12. (IFC) International Fire Code
13. (IPCEA) Insulated Power Cable Engineers Association
14. (IRC) International Residential Code
15. (ITL) Independent Testing Laboratories
16. (NETA) International Electrical Testing Association
17. (NBFU) National Board of Fire Underwriters
18. (NEMA) National Electrical Manufacturers Association
19. (NESC) National Electric Safety Code
20. (NFPA) National Fire Protection Association
21. (UL) Underwriters' Laboratories
22. Local Codes
23. Public Health Service Regulations
24. Local Utility Standards and Regulations

1.9 PERMITS

- A. General: Obtain all permits required for electrical work on the Project by all governing agencies having jurisdiction at the Project site.

1.10 QUALITY ASSURANCE

- A. Manufacturers' Qualifications: Not less than (3) years' experience in the actual production of the specified (or similar) products.
- B. Installers' Qualifications: Firm having not less than (5) years' experience in the installation of electrical systems and equipment similar in scope and complexity to those required for this Project and having successfully completed at least ten comparable scale projects.

- C. Incidental Work: Painting, patching, welding, carpentry and the like related to or required for Division 26 work shall be performed by craftsmen skilled in the appropriate trade, and shall be provided for under Division 26, unless indicated otherwise.

1.11 SUBMITTALS

- A. General: Prepare and submit for approval, all submittals required by this and subsequent Division 26 sections, and by all other Contract Documents for this Project.
- B. Types: Required submittals may include: Schedule of Values; List of Subcontractors and Materials; Product Data; Shop Drawings; Samples; Test Reports; Certifications; Warranties; Maintenance Manuals; Record Documents; Rebate Applications (including all submittals, backup information, copies of receipts, etc. needed to obtain all applicable electric utility company incentives); and other various administrative submittals.
- C. Number and Format: One electronic PDF format copy.
- D. Product Data: Submit for equipment, devices and materials as required in subsequent individual Division 26 sections. Product Data to consist of manufacturer's standard catalog cuts, descriptive literature and/or diagrams, in 8-1/2" X 11" format, and in sufficient detail so as to clearly indicate compliance with all specified requirements and applicable standards. Mark each copy to clearly indicate proposed product, included options, accessories, finish, size, type, etc.
- E. Shop Drawings: Submit for equipment and systems as required in subsequent individual Division 26 sections. Shop Drawings to be newly prepared, specifically for this project, and shall include all information listed in the shop drawing submittal requirements in the respective specification section. Include all pertinent information such as equipment/system identification, manufacturer, and model or series number where applicable, dimensions, nameplate data, sizes, capacities, types, fabrication materials, materials list, performance data, features, accessories, wiring diagrams, etc. in sufficient detail so as to clearly indicate compliance with all specified requirements and applicable standards. Submit Shop Drawings with related Product Data submittals.
- F. Operation and Maintenance Data: Upon completion of the work, prepare and deliver to the Owner complete operating and maintenance manuals for systems and major equipment installed as outlined in Division 1 of the project specifications. Include all updated materials listed above in submission, including as-built wiring diagrams.
- G. Maintenance Manuals: Include operating and maintenance data for each Division 26 section requiring a Product Data and/or Shop Drawing submittal. Include the respective Product Data/Shop Drawing submittals as well as descriptions of function, normal operating characteristics and limitations, and manufacturer's printed operating, maintenance, trouble shooting, repair, adjustment and emergency instructions and

diagrams, complete replacement parts listing, and the name, address and telephone number of the installing contractor and/or subcontractor, and for the nearest manufacturer's authorized service dealer.

- H. Record Documents: Prepare and submit in accordance with Division 1. In addition to Division 1 requirements, indicate actual installed locations for all electrical equipment and devices, routing of major interior building raceways, locations of all concealed and underground equipment and raceways, and all approved modifications to the Contract Documents, and deviations necessitated by field conditions and change orders.

1.12 INSPECTIONS

- A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all electrical work installed for the Project, in accordance with the Conditions of the Contract and this Section.
- B. Coordination: Coordinate and schedule all inspections with the Authority Having Jurisdiction as required. Coordinate inspections with requirements of the serving electric utility company.
- C. Inspections Required: Electrical rough-in inspection(s) and final electrical inspection(s) for all areas of building(s) where electrical work is being performed, and all site electrical work, and any other inspections required by the Authority Having Jurisdiction.
- D. Inspection Agency: Inspections shall be performed by an independent third party, approved inspection agency listed with the local building department.
- E. Certificates: Submit copies of all rough-in inspection certificates and all final inspection approval certificates to the Construction Manager, prior to requesting final payment(s).

1.13 PROJECT CONDITIONS

- A. Existing Conditions: Field verify all conditions that will determine exact locations, distances, levels, dimensions, elevations, etc. Review all drawings of other trades and report any conflicts to the Architect/Engineer which will affect the project cost.
- B. Dimensions: Dimensional information used for layout and locations shall be taken from architectural or structural drawings used by the construction trades and by field dimensions.
- C. Locations: Certain electrical drawings are diagrammatic and have no dimensional significance. Locations of equipment are to be as:
 - 1. Shown on the dimensioned drawings.
 - 2. Directed in the field.

3. Required for proper connection of equipment to be served.
 4. Required for proper symmetry in the space involved.
 5. With deviations made only with specific approval of Architect/Engineer.
- D. Coordination with the Other Trades: Division 26 shall review the drawings of other divisions, exchange shop drawings with them and cooperate in the preparation of space layouts as required to avoid conflicts and interferences with the installation of other trades in advanced stages of construction. Refer to Division 1 specification sections.
- E. Outlet Locations: The Architect reserves the right to relocate an outlet or outlets, 5' in any direction from locations indicated on plans, before roughing-in, with no change in contract price.

1.14 FIELD OBSERVATION REPORTS

- A. General: The EC shall receive field observation report(s) prepared by the Architect/Engineer. These field observation report(s) shall contain items which need further attention by the EC in order to fulfill the obligations of the contract. These field observation report(s) have space provided for the EC to sign off on each item when completed. The completion of the work listed on these field observation report(s) and the return of these signed off field observation report(s) to the Architect/Engineer by the EC is required to complete the contract obligation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Where Specified: Division 26 materials and equipment shall be as specified in subsequent Division 26 sections, and/or as indicated on the Drawings.
- B. General Requirements: All materials and equipment shall be in accordance with the Contract Documents, and to the extent possible, standard products (except where special construction or performance features are called for) of the specified or approved manufacturers. All materials and equipment shall be new, clean, undamaged, and free of defects and corrosion.
- C. Acceptable Products: The product of a specified or approved manufacturer will be acceptable only when that product complies with or is modified as necessary to comply with all requirements of the Contract Documents.
- D. Conformance: The EC shall verify that all materials he or his suppliers select conform to the requirements of the Drawings and Specifications. Transmittal of drawing and specification information to manufacturers supplying materials, and adherence to these requirements is the EC's responsibility. Approval of manufacturer's name by the

Architect/Engineer does not release the EC of the responsibility for providing materials which comply in all respects with the requirements in the Contract Documents.

- E. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.
- F. UL Listing: All electrical materials and equipment shall be Underwriters' Laboratories (UL) listed and labeled, where UL standards and listings exist for such materials or equipment.
- G. Permission to substitute equal or superior items of materials and equipment may be requested by following the procedure outlined in the Division 1 "Substitutions" of the project specifications. Completion date will not be extended because of any time lost due to consideration or installation of substitutions. All coordination of substituted equipment shall be the Contractor's responsibility.
- H. In purchasing materials and equipment to be furnished and installed under this contract the contractor shall convey to the Owner all rights and privileges extended by the various manufacturers thereof in the form of warranties and guarantees covering quality and performance of such items.
- I. All electric materials and equipment are to comply with all utility company requirements, where applicable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Letter and Intent: The installation of all electrical work shall be in accordance with the letter and intent of the Contract Documents, as determined by the Architect/Engineer.
- B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics skilled in the particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty or UL listing.
- C. Administration and Supervision: All electrical work shall be performed under the Contractor's direct supervision, using sufficient and qualified personnel as necessary to complete the work in accordance with the project progress and completion schedule. The Contractor shall assign one or more competent supervisors who shall have authority to accept and execute orders and instructions, and who shall cooperate with the Architect/Engineer and the Owner in all matters to resolve conflicts, avoid delays and complete the Project as efficiently as possible.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 requirements.
- B. Packing and Shipping: Deliver products to the Project site in original, unopened packaging, properly identified with the manufacturer's identification and shipping and handling instructions, and compliance labels.
- C. Delivery and Storage: Make provisions for delivery and safe storage of all materials. Check and properly receipt material to be "furnished by others" and assume full responsibility for all materials while in storage with full visible identification information.
- D. Storage Requirements: Comply with all manufacturer's written storage instructions and recommendations. Store all products in a manner which shall protect them from vandalism, damage, weather elements, and entry of debris.
- E. Large Equipment: Make the required arrangements with General Contractor for the introduction into the building of equipment too large to pass through finished openings.
- F. Damaged Products: Do not install damaged products. Arrange for prompt undamaged replacement.

3.3 EXAMINATION

- A. Conditions Verification: Examine the areas where, and conditions under which the work is to be performed, and identify any conditions detrimental to the proper and timely completion of the work. Do not proceed until the unsatisfactory conditions have been corrected or are no longer present.

3.4 COORDINATION

- A. General: Sequence, coordinate and integrate the installation of all electrical materials and equipment for efficient flow of work, in conjunction with the other trades. Review the Drawings for work of the other trades, and report and cooperate to resolve any discovered discrepancies, prior to commencing work.
- B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work. Resolve and minimize possible interferences in the work, prior to commencing installation.
- C. Chases, Slots and Openings: Arrange for chases, slots and openings during the progress of construction, as required to allow for installation of the electrical work.
- D. Supports and Sleeves: Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

- E. Obstacles and Interferences: When installing equipment and raceways, provide offsets, fittings, accessories and changes in elevation or location as necessary to avoid obstacles and interferences, per actual field conditions.

3.5 DIMENSIONS

- A. Building Dimensions: For exact locations of building elements, refer to dimensioned drawings. However, field measurements take precedence over dimensioned drawings.
- B. Limiting Dimensions: Equipment outlines shown on drawings or details of 1/4" = 1'-0" scale or larger, and dimensions indicated on the Drawings are limiting dimensions. Do not install equipment exceeding these dimensions unless specifically approved by the Architect/Engineer.

3.6 PROTECTION OF MATERIALS AND EQUIPMENT

- A. General: Protect all electrical work, materials, equipment, fixtures and devices from weather elements, paint, concrete, mortar, construction debris, theft, vandalism and damage throughout the construction period until final acceptance. Promptly replace any such damaged electrical work, materials, equipment, fixtures, devices.

3.7 CHECKOUT, TESTING AND ADJUSTMENTS

- A. Requirements: Schedule and provide testing equipment, materials, instruments and personnel as necessary to checkout and perform all test procedures and adjustments required by the respective manufacturer's written instructions or recommendations, the Contract Documents, and/or deemed necessary by the Architect/Engineer or Authority Having Jurisdiction to establish proper performance and installation of all electrical systems and equipment. All test instruments to be accurately calibrated and in good working order.
- B. Checkout: In addition to the above testing, perform the following checkouts:
- C. Wiring: Check all wiring for continuity and grounds before energizing any system.
- D. Fixtures and Equipment: Check for grounds, shorts, etc. on all fixtures, equipment, apparatus, etc.
- E. Heat Tests: Load test various parts of the system as directed by the Architect/Engineer, to determine if excessive heat is developed in panels, switches, wiring, etc.
- F. Test Scheduling: Coordinate and schedule tests at least one week in advance, and so as to allow the Construction Manager's, Architect/Engineer's and Owner's representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational, unless directed otherwise by the Engineer.

- G. Manufacturer's Authorized Representatives: When required by subsequent Division 26 sections, arrange and pay for the services of the manufacturer's authorized representative(s) to be on-site to supervise the start-up, checkout, testing and adjusting of the equipment or system, and to certify all required testing and adjusting.
- H. Test Reports: Submit test reports neatly typewritten on 8 1/2" X 11" sheets indicating system or equipment being tested, methodology of testing, date and time of test, witnesses of test, and test results. Submit test report in PDF format to the Construction Manager for review, within five days after test is performed, and include a copy in the appropriate section of the Maintenance Manual.
- I. Correction/Replacement: After testing, correct any deficiencies, and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Re-test without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken, and satisfactory results of re-test.
- J. Other Tests: Perform all testing as required by the Authority Having Jurisdiction, as may be required by serving electric utility company, and as required in all other Division 26 sections.

3.8 SYSTEMS DEMONSTRATION

- A. General: Instruct the Owner's representative(s) in the start-up, operation and maintenance of all electrical systems and equipment. Comply with specific requirements in subsequent Division 26 sections. All systems demonstrations shall be to the Owner's satisfaction.

3.9 CLEANING

- A. Perform cleaning as required by Division 1.
- B. General Cleaning: Periodically remove from the Project site, all waste, rubbish and construction debris accumulated from construction operations, and maintain order. The premises shall be left clean and free of any debris and unused construction materials, prior to Owner's acceptance.
- C. Electrical Equipment: Remove all dust, dirt, debris, mortar, wire scraps, rust and other foreign materials from the interior and exterior of all electrical equipment and enclosures and wipe down. Clean accessible current carrying elements and insulators prior to energizing.
- D. Lighting Fixtures: Thoroughly clean all lighting fixtures and lamps, just prior to final inspection. Fixture housings, reflectors, lenses, etc. shall be cleaned free of any dust, dirt, fingerprints, etc. by an approved method.

- E. Touch-Up Painting: Restore and refinish to original condition, all surfaces of electrical equipment scratched, marred and/or dented during shipping, handling or installation. Remove all rust, and prime and paint as recommended by the manufacturer.

END OF SECTION 260010

SECTION 260050 - GENERAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements, and basic materials and methods applicable for all Division 26 work. Limited scope general construction materials and methods for application with electrical installations are also included.
- B. This section also applies to all Division 27 and 28 work.

1.2 SUBMITTALS

- A. None Required.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

- A. Rigid steel conduit or iron pipe.

2.2 CONDUIT SEALS

- A. For Cast-in-Place Concrete Applications: Acceptable Manufacturers: O-Z/Gedney Type "FSK"; Thunderline Corp. "Link Seal Wall Sleeve".
- B. For Core Drill and Pre-Cast Opening Applications: O-Z/Gedney Type "CSML"; Thunderline Corp. "Link Seal".

2.3 FIRESTOPPING MATERIALS

- A. Requirements: Comply with Division 7 and the following.
- B. General: Firestopping systems composed of firestopping compounds and appropriate damming materials installed together with the penetrant (e.g. conduit) to form a complete firestopping system, providing a fire resistant rating at least equal to the hourly fire resistance rating of the floor, wall or partition into which the firestopping system is to be installed.
- C. Test Standards: Firestopping materials shall be tested together as a system to the time/temperature requirements of ASTM E119 and shall be tested to UL 1479 (ASTM E814) and be UL classified for up to (3) hours.

- D. Firestopping Sealants: Non-hardening, conformable, intumescent putties, sealants or other compounds, containing no toxic solvents or asbestos, and exhibiting aggressive adhesion to all common building materials and penetrants, while allowing reasonable movement of the penetrants, without being displaced. Compounds shall be waterproof, non-toxic and smoke and gas tight.
- E. Firestopping Mortars: Light-weight, water-based, cementitious, fast-drying, low density mortar, non-shrinking and non-cracking during its cure, and which forms a surface capable of being sanded, bored and painted.
- F. Damming Materials: Mineral wool or ceramic fiber.
- G. Acceptable Manufacturers: Dow Corning; Heavy Duty/Nelson; International Protective Coatings; Specified Technologies, Inc.

PART 3 - EXECUTION

3.1 ELECTRICAL INSTALLATION

- A. Finished and Unfinished Areas: For the purposes of these electrical specifications, mechanical and electrical equipment rooms shall be considered "unfinished" areas. All other areas of the building shall be considered "finished" spaces, unless approved otherwise by the Architect/Engineer.
- B. In Unfinished Areas: Raceways, equipment and devices may be installed concealed or exposed, unless indicated otherwise.
- C. In Finished Areas: Conceal all raceways and flush mount all electrical boxes, equipment, and devices unless specifically indicated or approved otherwise. The space above suspended ceilings or behind furred spaces is considered outside finished areas and electrical materials installed within these areas are considered concealed.
- D. Minimum Mounting Height: Install exposed raceway and all other electrical equipment (e.g., lighting fixtures) with not less than 7'-6" clear to finished floor, unless indicated or approved otherwise, and excluding raceway and equipment mounted on walls.
- E. Dimensions and Clearances: Field measure all dimensions and clearances affecting the installation of electrical work, in relation to established datum, building openings and clearances, and the work of other trades, as construction progresses.
- F. Rough-In Locations: Verify final locations for rough-ins with field measurements and requirements of actual equipment being installed.

- G. Door Swings: Verify the swings of all doors before switch outlet boxes and other electrical device boxes are installed. If necessary, revise outlet box locations so that devices are not obstructed by doors when doors are open.
- H. Equipment Mounted on Interior Side of Exterior Building Walls: When mounting panelboards, safety switches and other electrical equipment on interior side of exterior building walls, provide minimum 1/2" plywood mounting backboard.

3.2 LAYOUT

- A. General: Install electrical systems, materials and equipment level and plumb, and parallel and perpendicular to building surfaces, and other building systems components, wherever possible.
- B. Serviceability: Install electrical equipment and raceways, etc. so as to readily facilitate servicing, maintenance and repair or replacement of the equipment or its components, and so as to minimize interference with other equipment and installations.
- C. Clearances: Prior to commencing work, verify that all electrical equipment will adequately fit and conform to the indicated and NEC required clearances, in the spaces indicated on the Drawings. If rearrangement is required, submit plan and elevation drawings or sketches indicating proposed rearrangement, for Architect/Engineer approval. Do not rearrange equipment layouts without the written permission of the Architect/Engineer.
- D. Right-of-Way: When laying out electrical work, give priority in available spaces to new and existing steam and condensate lines, sanitary lines, drain lines, fire protection system piping, and sheet metal duct work. Provide offsets as necessary to avoid conflicts. Resolve all conflicts before commencing installation.

3.3 MOUNTING HEIGHTS

- A. General: Indicated heights are measured from the center of the device outlet box to the finished floor or grade, unless indicated otherwise. Request instructions for mounting heights not indicated.
- B. Adjustments: Adjust mounting heights in exposed masonry construction so that bottoms of outlet boxes are along the edges of blocks, unless indicated otherwise.

3.4 HOLES, SLEEVES AND OPENINGS

- A. General: Provide all holes, sleeves and openings required for the completion of Division 26 work and restore all surfaces damaged, to match surrounding surfaces. Maintain integrity of all new and existing fire and smoke rated barriers, using approved firestopping systems. When cutting holes or openings, or installing sleeves, do not cut,

damage or disturb structural elements or reinforcing steel, unless approved, in writing, by the Architect/Engineer.

- B. Conduit Penetrations: Size core drilled holes so that an annular space of 1/4" to 1" is left around the circumference of the conduit. When openings are cut in lieu of core drilled, provide sleeve in rough opening. Size sleeves to provide an annular space of 1/4" to 1" around the circumference of the conduit. Patch around sleeve to match surrounding surfaces.

3.5 CONDUIT SEALS

- A. General: Install conduit seal for each conduit penetrating an exterior building wall below grade (unless penetration is below lowest building floor slab), and elsewhere as indicated or required. Install seals so as to achieve a watertight installation.

3.6 CUTTING AND PATCHING

- A. General: Provide all cutting, drilling, chasing, fitting and patching necessary for accomplishing the work of Division 26. This includes any and all work necessary: to uncover materials to provide for the installation of ill-timed work; to remove and replace defective work and work not conforming to the Contract Documents; to install equipment and materials in existing buildings and structures; in addition to that required during the normal course of construction.
- B. Building Structure: Do not endanger the integrity of any building structure by cutting, drilling or otherwise modifying any structural member, without specific approval. Do not proceed with any modifications to building structure without written permission of the Architect/Engineer.
- C. Repairs: Repair any and all damage to work of any other trade on the Project caused by cutting and patching operations, using skilled mechanics of the trade(s) involved.

3.7 FIRESTOPPING SYSTEMS

- A. Requirements: Comply with Division 7 and the following.
- B. General: Install firestopping at all electrical raceway and cable penetrations through floor structures and interior walls or partitions which are time-rated fire and/or smoke barriers. Identify all such barriers from the Architectural Drawings.
- C. Preparation: Prior to installation, verify that all penetrating elements and supporting devices are permanently installed and that surfaces which will be in contact with the penetration sealing materials are clean and free of dust, dirt, grease, oil, loose materials, rust and other foreign substances.

- D. Installation: Install firestopping systems in accordance with UL approved design details and the manufacturer's written instructions. Install sleeves, conduits and cables with required clearance spaces, allowing adequate installation of the sealing materials. Do not exceed the outside diameter of the sleeve, conduit or cable by more than 1" or by less than 1/4" when making openings for penetrations. Install firestopping systems so as to completely seal openings to prevent the passage of smoke and water.

3.8 WELDING

- A. Where welding is required, such welding shall be performed in a skilled manner by certified welders. Verify that all welds are free from cracks, craters, undercuts and strikes, weld spatter, and any other surface defects. Clean and re-weld any welds which are defective in any way.

3.9 ELECTRICAL REMOVALS WORK

- A. General: Remove existing electrical equipment, devices, raceways, wiring and related materials within the Project work limits, as indicated, specified, and required for successful Project completion.
- B. Existing Conditions: In general, existing electrical systems are not shown on the Drawings unless pertinent to the work of this Project. Existing electrical conditions, where indicated, are based on casual field observations and/or drawings for previous construction, and must be field verified. Report any discrepancies to the Architect/Engineer before disturbing the existing installation.
- C. Examination: Prior to bidding, examine the Project site to determine all actual observable conditions, building dimensions, and locations of existing electrical equipment, etc. No additional compensation will be granted on account of extra work made necessary by the Contractor's failure to investigate such existing conditions.
- D. Items to be Salvaged: Before commencing work of this Section, verify with the Owner and Architect/Engineer, which (if any) existing electrical systems, materials, equipment and devices being removed under this Project are to be salvaged.
- E. Inspection: Carefully inspect the Project site and become familiar with the existing systems and conditions, before proceeding with the work.
- F. Coordination: Coordinate all removals and changeover work with the Owner.
- G. Protection of Adjacent Materials: During execution of removals work, give primary consideration to protecting from damage, the building structure, furnishings, finishes and the like, unless specifically indicated to be removed. Existing items or surfaces to remain, which are damaged as a result of this work shall be refinished, repaired or replaced to the satisfaction of the Architect/Engineer, at no cost to the Contract.

- H. Patching: When electrical materials are removed or modified, patch and finish walls, ceilings, floors and other surfaces to match surrounding surfaces. Provide blank coverplates, etc. as required. Materials used for patching shall match existing materials.
- I. Shutdowns: All shutdowns to existing electrical services and systems to be scheduled and approved at least one week in advance, in writing, by the Owner.
- J. Temporary Connections: Where electrical services are required to be temporarily disconnected due to project requirements, provide temporary services to maintain existing operations up until the time permanent services are restored. Coordinate with the Owner.
- K. Disconnections: Disconnect electrical devices and equipment as specified and required.
- L. Wire/Cable Removals: Where existing electrical devices or equipment are indicated or required to be removed, remove all associated wire/cable. Remove all abandoned or dead wiring back to source.
- M. Raceway Removals: Remove all abandoned raceways, boxes, supports, etc., unless indicated otherwise.
- N. Reconnections: Where existing electrical circuits serving existing lighting fixtures, wiring devices, etc. which are to remain (i.e. not indicated to be removed) become disconnected or otherwise disrupted as a result of remodeling work, reroute and reconnect circuits, provide new circuiting, etc. as required to restore original operation to the existing fixtures and devices remaining. Reconnection work to comply with requirements for new work.
- O. Existing Electrical Work to Remain: Protect and maintain access to all existing electrical work indicated and/or required to remain. Repair and reinstall any such existing electrical work disturbed.
- P. Items to be Salvaged: Carefully remove and store on site where directed by the Owner, all material and equipment which is specified, indicated (or directed by the Owner) to be salvaged.
- Q. Items to be Reused/Relocated: Carefully remove and store on site, all material and equipment indicated to be reused or relocated. Thoroughly clean, and make any necessary minor repairs to such equipment, prior to reinstallation.
- R. Items to be Removed: Remove and legally dispose of all materials (except salvage or relocation items) and debris resulting from demolition work.

- S. Cleaning: Remove from the Project site all dirt, dust and debris, etc. resulting from demolition work, on a daily basis. Do not block or otherwise impair circulation in corridors, stairs, sidewalks, roadways or other traffic areas.

END OF SECTION 260050

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SECTION 260501 - ELECTRICAL MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Basic electrical materials and installation. Limited scope general construction materials and methods for application with electrical installations, applicable to all Division 26 work, are also included.
- B. Applicability: Section applies to all Division 26 work, and also to Division 27, 28 work as applicable.

1.2 INSTALLATION - GENERAL

- A. Use of Drawings and Field Conditions: The drawings are diagrammatic, unless detailed dimensioned drawings are included, and show only approximate locations of equipment, fixtures, panelboards, conduits, and wiring devices. Exact locations are subject to the approval of the Owner's Representative. The general run of electrical feeders, branch circuits, and conduits/raceways indicated on the drawings is not intended to be the exact routing. Field route conduits and raceways to suit job conditions.
- B. Installation and Measurements: Make measurements at the site and in the building during construction for all systems installed, as the work progresses, in such a manner that equipment, piping, ducts, conduits/raceways and boxes will fit in the space available. Maintain minimum 7'-6" headroom wherever possible, and in unfinished areas, install electrical equipment and conduits/raceways neatly and as obscure and "out-of-the-way" as physically possible.
- C. Coordination: Where more than one trade is involved in an area, space or chase, cooperate with the other trades and install work to utilize the space equally in proportion to their individual trade requirements. In general, ductwork shall be given preference except where grading of piping becomes a problem, followed by piping, and then electrical conduits and raceways. If, after installation of any equipment, piping, ducts, conduits/raceways, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and /or furnish other equipment as required for adequate space.
- D. Field Changes: If changes in the size or location of the material or equipment supplied is necessary in order to meet field conditions or to avoid conflicts between trades, bring such matters to the immediate attention of the Architect/Engineer and gain approval before proceeding with such alterations.

1.3 QUALITY ASSURANCE

- A. General: Install electrical equipment in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Architect/Engineer.
- B. Equipment and Materials: Of the quality and manufacture specified. Equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equal in every way to that of the equipment specified and is subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature and any other information necessary to indicate compliance with the specified requirements Submit product data for the following:
 - 1. Raceways.
 - 2. Outlet, Pull and Junction Boxes.
 - 3. Conductors.
 - 4. Type "MC" Cable.
 - 5. Wiring Devices and Coverplates.
 - 6. Safety Switches.
 - 7. Panelboards and Circuit Breakers.
 - 8. Lighting Fixtures.

PART 2 - PRODUCTS

2.1 RACEWAYS

- A. General: All raceways shall meet applicable NEMA standards and be UL-Listed with each length so labeled.
- B. Acceptable Manufacturers- Metallic Raceways: American Flexible Conduit Company; Republic Conduit; Allied Tube and Conduit; Wheatland Tube Company.
- C. Acceptable Manufacturers- Rigid Non-Metallic Conduits: Cantex; Carlon; National Pipe and Plastics; Queen City Plastics, PW Eagle.
- D. Rigid Metal Conduit: Manufactured from mild steel, hot-dipped galvanized inside and out including threads, conforming to ANAI C80.1 and UL-6.
- E. Electrical Metallic Tubing: Manufactured from mild steel, hot dipped galvanized inside and out, conforming to ANSI C80.3 and UL-797.

- F. Flexible Metal Conduit: Constructed in one continuous length of electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges, conforming to UL-1.
- G. Liquid-Tight Flexible Metal Conduit: Same as flexible metal conduit, with extruded liquid-tight PVC jacket, and conforming to UL-360.
- H. Rigid Non-Metallic Conduit: Schedule 40 heavy wall and Schedule 80 extra-heavy wall 90oC, PVC rigid plastic conduit, conforming to ASTM F-512, NEMA TC-2 and UL-651.
- I. Metal Conduit Fittings:
 - 1. UL-listed for the intended application, steel or malleable iron, conforming to ANSI/NEMSA FB-1. Fittings for rigid metal conduit shall be fully threaded. Connectors 1 -inch size and smaller to include insulated throat. Connectors larger than 1-inch size to include plastic insulating bushing.
 - 2. Do Not Use: Die-cast, pressure cast or set-screw type fittings.
 - 3. Acceptable Manufacturers: O.Z Gedney; Steel City; Thomas & Betts; Crouse-Hinds.
 - 4. Non-Metallic Conduit Fittings: Solvent cemented, compatible with specified rigid non-metallic conduit. Acceptable Manufacturers: Same as for Rigid Non-Metallic Conduits.
- J. Wireways:
 - 1. General: UL listed, sheet steel construction with gray baked enamel finish, NEMA-1 for indoor dry locations, other NEMA types as required to suit the application, and supplied in standard sectional lengths. Include snap-in wire retaining spring clips where necessary to hold conductor in place.
 - 2. Size: Cross section per NEC or as indicated.
 - 3. Covers: Screw on type, unless indicated otherwise.
 - 4. Fittings and Accessories: Elbows, tees, pull boxes, hangers, reducers, supports, hardware, etc. as required for a complete installation.
 - 5. Acceptable Manufacturers: Square D; Hoffman; Meco.

2.2 BOXES

- A. Outlet Boxes:
 - 1. Type: Non-gangable galvanized steel, with square cornered tile (or masonry) type extension rings or covers.
 - 2. Minimum Box Size: As required by the NEC, but minimum 4" square or two-gang masonry box, and minimum 2" deep unless restricted by the surroundings.
 - 3. Mounting: Boxes and associated fittings, plates and devices shall be mechanically fastened (screwed). Friction fitting not acceptable.
 - 4. Outlet Boxes Exposed to Moisture, Exterior, Wet or Damp Locations: Cadmium cast alloy or malleable iron, complete with external threaded hubs and gasketed

screw fastened covers. Boxes shall be approved for the environmental condition where they will be installed.

5. Acceptable Manufacturers: Steel City; Raco; Appleton; Crouse Hinds.

B. Junction and Pull Boxes:

1. Sized per NEC.
2. General (Dry Location) Use: Minimum 14-gauge galvanized steel with trim for flush or surface mounting as applicable, and screw-on type covers.
3. Damp and Wet Location Use: Raintight construction with gasketed cover and threaded conduit hubs. Boxes shall be approved for the environmental condition of the location where they will be installed.
4. Acceptable Manufacturers: Hoffman; Keystone.

2.3 RACEWAY STRIPS

A. General:

1. Types: As specified and indicated.
2. Finish: Baked enamel, ivory color.
3. Accessories: All fittings, plates, adapters, extension covers, oversize boxes, hardware, etc. as required for a complete installation.

B. Type "X" Raceway Strips:

1. Description: Low profile, one-piece .040" thick galvanized steel surface raceway consisting of factory assembled base and cover section, designed for pulling in conductors.
2. Finish: Ivory.
3. Acceptable Manufacturers: Wiremold #200, 500, 700 Series.

2.4 TELECOM POWER POLES

General: In general, match existing per building, with height as required to be approx. 6-12" above finished ceiling, color ivory, with receipts and telecom outlets as indicated.

Acceptable Manufacturers: Wiremold or approved equal.

2.5 CONDUCTORS (BUILDING WIRE)

- A. Description: 600 volts class, in standard AWG and kcmil sizes. Conductors shall be 98 percent uncoated copper, with heat and moisture resistant type THHN/THWN-2 insulation.
- B. Size: As indicated and per NEC, and minimum #12 AWG except smaller sizes may be used for control circuits, and communications and special systems (see respective specification sections).

- C. Stranding: Conductors size #14 through #10 AWG may be solid or stranded. Conductors sizes #8 AWG and larger to be Class B stranded. Conductors sizes #16 AWG and smaller shall be solid single strand.
- D. Labeling: For full length of conductor, indicating UL seal, manufacturer's name, wire size and insulation type.
- E. Insulation Colors: Color impregnated insulation, in colors to meet color coding requirements in Part 3.
- F. Acceptable Manufacturers: General Cable; Southwire; Cerro Wire.

2.6 TYPE "MC" CABLE

- A. Note: Use only where permitted in PART 3 below.
- B. General: Factory-assembled multi-conductor cable with individually insulated conductors, including a separate equipment grounding conductor, enclosed in a metallic sheath, conforming to UL-1569.
- C. Fire Rating: Three-hour, per UL-1479, for walls and floor-ceiling assemblies.
- D. Plenum Rated: For use in air-handling spaces per NEC 300.22(C).
- E. Conductors: Solid copper, type THHN insulation, 90oC.
- F. Conductor Color Code: Same as for individual building wire.
- G. Wire Sizes Permitted: #12 AWG through #10 AWG.
- H. Metallic Sheath: Interlocked galvanized steel armor with green stripe.
- I. Metal Sheath Grounding: #16 AWG integral bond wire/armor combination per NEC 250.118 (8).
- J. Fittings: UL-listed, conforming to ANSI/NEMA FB-1, made of steel or malleable iron, and designed specifically for Type "MC" Cable. Do not use die-cast or pressure-cast fittings.
- K. Acceptable Manufacturers (Cable): AFC; General Cable; Southwire.
- L. Acceptable Manufacturers (Fittings): Appleton; Crouse-Hinds; Midwest Electric; O-Z/Gedney; Raco; Steel City; Thomas & Betts.

2.7 CONDUCTOR LUGS AND CONNECTORS

- A. General: UL listed, factory fabricated, designed for respective application, conductor type and size, and rated for continuous operation at the current rating of its respective conductor. Compression fittings to utilize industry standard crimping tools and dies.
- B. Acceptable Manufacturers: Amp; Burndy, Ilco; Ideal; O.Z/Gedney; 3M; Thomas & Betts.
- C. Connectors (#10 AWG and Smaller): Nylon shell insulated spiral steel spring type screw-on connectors.
- D. Terminations (#10 AWG and Smaller, Stranded): Nylon insulated crimp ring or fork type connectors for connecting conductors to screw terminals.
- E. Connectors (#8 AWG and Larger): Compression type, with molded plastic insulators.
- F. Lugs (#8 AWG and Larger): Compression type.

2.8 WIRING DEVICES AND COVERPLATES

- A. General: Specification grade as a minimum, unless otherwise specifically indicated
- B. Device Color: Light almond (confirm with Architect).
- C. Acceptable Manufacturers: Hubbell; Pass and Seymour (Legrand); Leviton.
- D. General Use Switches: 20 amp, 120-277 volt, toggle type, quiet operation, quick make-quick break, side/back wired, with nylon or polycarbonate toggle, self-grounding mounting screw clip plate (not staple), ground terminal and silver alloy contacts.
Acceptable Manufacturers: Hubbell #HBL1221, P&S #PS20AC1 or Leviton #1221-2 series.
 - 1. Types: Single-pole, two-pole, three-way, four-way, illuminated handle, keyed, etc. as indicated.
- E. General Use Receptacles: NEMA 5-20R, duplex, 20A, 125V, side/back wired, #14 to #10 AWG screw terminals, nylon face, indented brass contacts for three point connection, self-grounding mounting screw clip plate (not staple). Acceptable Manufacturers: Hubbell #5362B, P&S #5362 or Leviton #5362-S series.
- F. Ground Fault Circuit Interrupting (GFCI) Receptacles: "Decorator" style, NEMA 5-20R configuration, 20 amp, 125 volt A.C., duplex type, ground fault circuit interrupter type, feed-through, specification grade, with test and reset buttons, complying with latest UL requirements. Receptacle to be of high-impact thermoplastic construction, with button colors to match face, and red trip indicator light. Receptacle to include diagnostic indication for mis-wiring, to exceed UL943 voltage surge requirements, and to disconnect power to receptacle if ground fault protection is lost. Ground fault sensing to be Class A, 5 +/- 1 mA trip level, 0.025 seconds trip time. Acceptable Manufacturers: Hubbell #GFTWRST20, P&S #2097TR, or Leviton #GFTR2 series.

- G. Special Receptacles: As indicated on the drawings by ratings and/or NEMA configuration. For each special receptacle on the Project, furnish a matching 6' to 10' long (as required) cord and plug set, and connect to respective equipment, unless respective equipment is furnished with same.
- H. Coverplates (Interior Devices): Struck-up type, minimum .032" thick, Type 430 stainless steel with U.S. #32D satin finish, with number of gangs and openings to suit the number and type of wiring devices. Acceptable Manufacturers: Hubbell; Pass and Seymour; Leviton.
- I. Coverplates- Surface Mounted Boxes: Galvanized steel, rounded raised.
- J. Weatherproof Receptacle Coverplates: Weatherproof, cast aluminum with hinged and neoprene gasketed stay-open while-in-use cover and stainless-steel hardware. Acceptable Manufacturer: Steel City or approved equal.

2.9 EQUIPMENT CONNECTIONS

- A. General: Materials as specified in this Section, and as indicated or required.

2.10 HANGERS AND SUPPORTS

- A. Materials and Design: All hangers, supports, fasteners and hardware shall be zinc-coated or equivalent corrosion resistance by treatment or inherent property, and shall be manufactured products designed for the intended application. Products for outdoor use shall be hot dipped galvanized.
- B. Types: Hangers, straps, riser supports, clamps, U-channel support systems, threaded rods, etc. as indicated and required.
- C. U-Channel Supports: Steel with electroplated zinc finish for interior dry locations. Wet location and exterior channel support systems shall be steel with hot dipped galvanized finish and stainless-steel hardware as a minimum. Cut ends shall be touched up with suitable matching finish. Provide all necessary accessories including bolts, screws, anchors, connection plates, and straps as required for a complete installation.
- D. Acceptable Manufacturers: Unistrut; Globe; Kindorf; B-Line.

2.11 ELECTRICAL IDENTIFICATION

- A. Nameplates: Three-layer laminated plastic with minimum 3/16" high white engraved characters on black background, and punched for mechanical fastening. Fasteners to be self-tapping stainless-steel screws or number 10-32 stainless steel machine screws with nuts and flat and lock washers.

- B. Marking Pens: Permanent, waterproof, quick drying, black ink. Acceptable Manufacturers: Sanford's No. 3000 "Sharpie", or equal.
- C. Wire Tags: Vinyl or vinyl cloth self-adhesive wraparound type, indicating appropriate circuit number, etc.
- D. Wiring Device Circuit Labels: Machine prepared adhesive label tapes, indelible black ink on clear background. Size so as to be easily legible, and consistent throughout.
- E. HVAC Equipment Circuit Labels: Machine prepared adhesive label tapes, indelible black ink on white background. Size so as to be easily legible, and consistent throughout.
- F. Panelboard Circuit Directories: Manufacturer's standard cards.

2.12 GROUNDING

- A. Conductors: As specified elsewhere in this section, and as indicated.
- B. Clamps and Pressure Connectors: Cast copper, copper alloy, or bronze alloy, suitable for use with aluminum and copper. Double-bolt type with formed shoe and "U" cable clamp for connection to pipe or conduit; single-bolt type with cable shoe and "U" cable clamp for connections to flat bar or metal; and double-bolt, parallel conductor split clamp type for cable to cable connections.

2.13 SAFETY SWITCHES

- A. General: NEMA heavy duty, horsepower rated, fully enclosed, fusible (with rejection fuse clips) or non-fused as indicated, quick-make, quick-break switching mechanism interlocked with cover, and NEMA-1 (indoors) or NEMA-3R (outdoors) enclosure unless indicated otherwise.
- B. Ratings and Poles: Provide switches with ratings and number of poles as indicated (or as required to suit load if ratings are not indicated).
- C. Solid Neutral: Include for all switches where neutral conductor is present.
- D. Equipment Ground: Include equipment ground kit for each switch.
- E. Acceptable Manufacturers: ABB/General Electric; Eaton; Schneider Electric/Square D.

2.14 PANELBOARDS AND CIRCUIT BREAKERS

- A. General: Ratings, mains, mounting and complement of branch overcurrent protective devices as indicated below or on the Drawings.
- B. Type: Two-row circuit breaker branch circuit and distribution panelboards.

- C. Short Circuit Ratings: Minimum 10,000 amps (120/208 volt panelboards) and 14,000 amps (277/480 volt panelboards). Provide panelboards with higher ratings as indicated.
- D. Enclosures: NEMA-1 unless indicated otherwise, code gauge galvanized steel rough-in box and dead front, sheet steel cover with gray enamel finish, latch and lock. Include plastic covered circuit directory card and holder.
- E. Bussing: Copper. Include ground bus, bonded to enclosure.
- F. Circuit Breakers: Bolt-in, molded case with thermal and magnetic trips unless indicated otherwise. Minimum RMS symmetrical interrupting capacities of 10,000 amps for all breakers in 120/208 volt panelboards, and 14,000 amps for all breakers in 277/480 volt panelboards. Provide breakers with higher ratings where indicated or necessary to meet required panelboard short circuit ratings. Lower rated overcurrent protective devices based on series ratings with upstream devices will not be acceptable.
 - 1. "HACR" Rating: All circuit breakers serving air conditioning equipment (e.g. condensing units and roof top units) to be "HACR" rated.
- G. Order of Branch Breakers: Branch circuit panelboard breakers to be arranged in order as indicated in the panelboard schedules.
- H. Individual Enclosed Circuit Breakers: Provide individual enclosed circuit breakers with NEMA-1 enclosure (unless indicated otherwise), with ratings and features as indicated.
- I. Acceptable Manufacturers:
 - 1. Branch Circuit Panelboards: ABB/General Electric "A" series; Eaton "Pow-R-Line C" series; Schneider Electric/Square D "NQOD" series.
- J. Panelboard Schedules: Refer to the panelboard schedules on the Drawings.
- K. Circuit Breakers to Be Added to Existing Panels: Ampere ratings as indicated. Match existing manufacturer (or compatible), and voltage and interrupting ratings.

2.15 LIGHTING FIXTURES

- A. General: Fixture types as described in the Lighting Fixture Schedule (see below). Lighting fixture manufacturers' series or catalog numbers listed indicate general quality, type, and style, but may not cover any or all required design details or options. Provide lighting fixtures having features, details and accessories as noted in the fixture descriptions and in this specification section. Provide all fittings, hangers, clamps, brackets, yokes, flanges and miscellaneous devices required for a complete installation.
- B. Mounting: Confirm ceiling type and associated mounting requirements for each fixture type with the Architect, prior to preparing submittals.

- C. LED Lamps and Drivers: As scheduled in the Lighting Fixture Schedule (see below). Drivers to include 0-10 VDC dimming, range specified, unless indicated otherwise.
- D. Lighting Fixture Schedule: See notes on Drawings, and/or 265001- Lighting Fixture Schedule (if applicable).

PART 3 - EXECUTION

3.1 RACEWAYS

- A. General: Install raceways continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond each raceway to each associated box and cabinet so that raceway system is electrically continuous throughout.
- B. Sizing: Size raceway as required by the National Electrical Code (minimum) with oversize conduits as indicated and where required for ease of pulling wire or cable.
- C. Minimum Conduit Size: 1/2" unless indicated otherwise. Minimum 3/4" for panelboard homeruns.
- D. Types: Unless indicated otherwise, use raceway types as follows:
 - 1. Indoors, Concealed in Walls or Above Ceilings: EMT.
 - 2. Indoors, Exposed: Use rigid galvanized steel conduit below five feet above finished floor. EMT may be used above five feet.
 - 3. Outdoors, Exposed: Rigid galvanized steel conduit.
 - 4. Flexible Metal Conduit: Use in dry locations only, for connections to vibrating equipment, and equipment requiring minor adjustments in positions, for final connections to recessed lighting fixtures, between outlet boxes in stud partitions, and for all final connections to all indoor transformers.
 - 5. Liquid-Tight Flexible Metal Conduit: Use where flexible metal conduit connections are required in damp, wet or oily locations, and for final connection to all motors and motorized equipment.
 - 6. Wireways: As indicated or required.
- E. Routing: As required by job conditions unless specific routes or dimensioned positions are indicated on the Drawings. Install tight to slabs, beams and joists wherever possible. Minimize bends and offsets as much as practicable. Verify exact locations of all raceways, pull boxes, and junction boxes. Resolve any potential conflicts before commencing installation. Route exposed conduit, and conduit installed above ceilings, parallel or perpendicular to walls, ceilings and structural members. Install to maintain maximum possible headroom and to present a neat appearance.
- F. Installation (General): In accordance with the NEC and NECA's "Standards of Installation". Cut conduit ends square using saw or pipe-cutter and ream each cut end smooth. Bush

where necessary. Carefully make all conduit bends and offsets so that the inside diameter of pipe is not reduced. Make bends so that legs are in the same plane. Make offsets so that legs are in the same plane and parallel. Protect stub-ups from damage, and carefully re-bend when necessary.

- G. Fittings: Make up all raceway fittings tight so that final installation of raceway, fittings and enclosures constitutes a firm mechanical assembly and a continuous electrical equipment grounding conductor. Where required, provide bonding jumpers to assure electrical continuity.
- H. Conduit Support Spacings: No greater than allowed by NEC for the respective conduit type. Securely fasten each conduit within 3 feet of each connecting outlet box, junction box, cabinet or fitting.
- I. Protection: Protect and cap all raceways, enclosures and equipment during construction to prevent entry of concrete, mortar, debris and other foreign matter. Free clogged conduits of all obstructions, or replace, prior to pulling wire. Do not pull wire until building is completely enclosed.
- J. Heat Producing Equipment and Hot Surfaces: Maintain not less than 12 inches clearance between all raceways systems and any such equipment/surfaces.
- K. Expansion Joints: Provide expansion fitting for each conduit crossing a building expansion joint so that no undue stress is placed on the conduit due to the proper functioning of the expansion joints.
- L. Penetrations Through Structural Members: If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Architect/Engineer and obtain written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.
- M. Conduits Passing Through Roof: Where a conduit punctures the roof, install pitch pocket as required in order that the roof warranty is maintained. Coordinate with representative of roofing material manufacturer.
- N. Flush Mounted Panelboards: At each flush mounted panelboard, terminal cabinet, control cabinet, etc., provide four spare $\frac{3}{4}$ -inch. conduits from panelboard, etc., to an area above the nearest accessible ceiling space. Make 90° turn above the ceiling, arranged for further continuation of raceway, and cap.
- O. Bushings: Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to provide equivalent protection to conductors. Provide grounding type insulated bushings on all conduit sizes 1-1/4-inch trade size and larger, and on all feeder raceways regardless of size. Provide standard bushings for conduits 1-inch and smaller.

- P. Differing Temperatures: For raceways routed between areas with differing temperatures (interior to exterior, etc.) install raceway as follows:
 - Q. Provide a thermal break, 4 in. minimum of stainless steel conduit within space wall/separation.
 - R. Seal raceway penetration through the wall/separation.
 - S. Provide a box on each side of the space wall/separation.
 - T. Provide raceway interior sealant (duct seal or suitable foam) to provide a complete air barrier after conductors are installed.
 - U. Mounting of raceway and boxes on equipment shall be coordinated and approved by the equipment manufacturer.
 - V. Raceways On Wet, Damp or Exterior Walls: Provide spacers to maintain a minimum 1/2" space/void between the mounting surface and the raceway.
- 3.2 OUTLET BOXES
- A. Size: As specified and per NEC.
 - B. Locations: Outlet locations shown on Drawings are approximate only. Study architectural, mechanical, plumbing and structural drawings and roughing-in, and note surrounding areas in which each outlet is to be located. If necessary, adjust outlet location so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts exist between drawings, contact Architect/Engineer for resolution prior to rough-in.
 - C. Location Changes at Architect's Discretion: Prior to rough-in, relocate any outlet up to a distance of five feet in any direction from location indicated on Drawings if so directed by the Architect/Engineer. Prior to completion of wall construction, adjust vertical height of any outlet from height indicated on Drawings if so directed by Architect/Engineer. Make the above modifications at no additional cost to the Owner.
 - D. Horizontal Alignment: Where outlets at different mounting heights are indicated on drawings adjacent to each other (due to lack of physical space to show symbols on drawings), install outlets on a common vertical line.
 - E. Light Switch Outlets: Where shown adjacent to strike side of a door, locate edge of outlet box approximately three inches from door frame.

- F. Adjoining Rooms: Do not install outlet boxes "back-to-back" in common wall separating two adjacent rooms without the approval of the Architect/Engineer. Do not use through-wall boxes.
- G. Outlet Boxes in Plaster, Gypsum Board or Wood Paneled Hollow Cavity Walls: Install flush using raised tile covers. Mechanically fasten and support from two adjacent structural members (studs) with cross brackets (Garvin Industries Model "BMB" or equal).
- H. Outlet Boxes in Tile, Brick or Concrete Block Walls: Install flush using extra-deep type raised tile covers or use 3-1/2 inch deep boxes with square corners.
- I. Surface Wall Mounted Outlet Boxes: Use cast type boxes.
- J. Outlet Coverplates: Install a device coverplate over each and every outlet indicated on drawings, unless indicated to be provided by others. Provide blank plate for each outlet without an indicated device. Do not install coverplates until painting, cleaning and finishing of surfaces surrounding the outlet are complete.
- K. Multi-Gang Outlets: Install single one-piece multi-gang covers over multi-gang devices.

3.3 JUNCTION AND PULL BOXES

- A. General: Provide as indicated and as useful/necessary to suit field conditions, length of and number of bends per conduit run, and for ease of pulling conductors/cables.
- B. Size: As indicated and per NEC.
- C. Installation: Install all junction and pull boxes rigidly, plumb and level. Support and secure boxes independently from conduits terminating at box. Install boxes so as to be readily accessible and so that covers may be easily removed.

3.4 RACEWAY STRIPS

- A. General:
 - 1. Inspection: Examine surfaces to receive raceway strips to make certain they are straight, true, and dry. Report any discrepancies and proceed only when corrected.
 - 2. Installation: Install raceway strips plumb, square and level, centered in spaces and at heights indicated.
 - 3. Complete System: Provide all miscellaneous components, hardware, etc. as required for a complete installation.
 - 4. Grounding: Bond each raceway strip to the conduit system(s) serving the strip, at each service point. Maintain continuity of adjoining sections via grounding jumpers. Ground each receptacle device in each raceway strip using an equipment grounding conductor.

B. Type "X" Raceway Strips:

1. Uses Permitted: In renovation areas only. (May not be used in areas with new wall construction). Use where specifically indicated, and elsewhere only in areas where existing walls are to remain, and there only where existing wall construction makes concealed conduit installation impractical (e.g. solid brick or concrete walls). Obtain prior written approval for each location where surface raceway is to be installed. Exact configurations and routing are subject to the Architect/Engineer's approval.

3.5 TELECOM POWER POLES

- A. General: Firmly support and install where indicated. Provide indicated devices and outlets and make all required connections.

3.6 WIRING METHODS

- A. General: All wiring systems to be composed of individual 600 volt class wires installed in specified raceway systems, except as follows:
- B. Type "MC" Cable: May be used only in the permitted sizes listed above, and then only for interior branch circuiting concealed in accessible ceiling spaces or in stud partitions. Do not use elsewhere. Do not use anywhere where exposed (e.g. in mechanical and electrical equipment rooms, storage rooms without ceilings, etc.). Comply with installation requirements below.

3.7 CONDUCTOR SIZES AND QUANTITIES

- A. Minimum Conductor Size: All branch circuit wiring shall be minimum #12 AWG. All control circuit wiring shall be minimum #14 AWG. Provide larger sizes as indicated or required for NEC required ampacity derating. All feeders and circuits to be same conductor size for full length of run from source to termination, unless indicated otherwise.
- B. Branch Circuit Conductor Sizes: Provide branch circuit wire sizes as indicated. Neutral wire sizes to match respective phase wire sizes unless indicated otherwise.
- C. Branch Circuit Common Neutrals: (Not permitted).
- D. Combining Homeruns: Do not combine separately indicated homeruns in single conduit unless specifically approved by the Architect/Engineer.
- E. Maximum Number of Conductors in Branch Circuit Raceways: Nine. Upsize conductor sizes for ampacity adjustments as required by 2014 NEC Table 310.15(B)(3)(a).
- F. Switch Legs: Provide branch circuit switch legs and travelers as required for the switching indicated.

- G. Service and Feeders: Provide service and feeder conductor sizes and quantities as indicated. Do not combine more than one feeder into a single conduit.
- H. Equipment Grounding Conductor Required: For each branch circuit and feeder run, provide an equipment grounding conductor, sized per NEC (minimum, larger if so indicated) whether indicated or not.

3.8 CONDUCTOR INSTALLATION

- A. General: Install all conductors, cables and associated items in compliance with all applicable requirements of the NEC, NEMA, UL and NECA's "Standards of Installation", and in accordance with the respective manufacturer's recommendations.
- B. Terminations: Furnish and install terminations, including lugs if necessary, to make all electrical connections indicated or required. Enclose all strands of stranded conductors in connectors and lugs.
- C. Tightening: Tighten all connectors, lugs, screws, bolts, Allen-heads and other electrical fasteners to torque values per manufacturer's written instructions.
- D. Restrictions: Do not substitute smaller conductors with higher temperature rated insulations in lieu of the conductors shown on the Drawings.
- E. Conductor Installation- General: Do not install conductors/cables until respective raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L. approved cable lubricants when necessary. Do not use mechanical means to pull conductors #8 AWG or smaller.
- F. Phases and Grounds: All wiring systems shall be properly grounded and continuously polarized throughout, following the specified color-coding.
- G. Feeder Connections: Make all feeder connections to bus and other equipment using solderless, pressure type terminal lugs.
- H. Branch Circuit Splices and Taps, #10 AWG and Smaller: Use specified nylon shell insulated spiral steel spring type screw-on connectors.
- I. Splices and Taps, #8 AWG and Larger: Use insulated solderless set-screw AL/CU or hydraulically compressed sleeve fittings suitable for the intended use.
- J. Slack Conductor Lengths: Provide minimum six inches of slack length for each conductor in each junction box, pull box and termination. For branch circuit outlets, leave a minimum of 8 inches free conductor length for connections of devices and fixtures.

- K. Splices and Connections: Make in accessible boxes and cabinets only.
- L. Uninsulated Splices and Free Conductor Ends: Completely insulate with rubber and friction tape, PVC electrical tape, or plastic insulating caps. Heat shrink sleeves are acceptable for crimp and compression type splices.
- M. Feeder Conductors: Install continuous from point of origin to load termination without splice. If this is not practical, contact the Architect/Engineer and receive written approval for splicing prior to installation of feeder(s). Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors as nearly equal as possible.
- N. Conductors in Panelboards and Control Panels: Neatly train and bind together using "Ty-Raps" or equal.
- O. Vertical Conduit Runs: Provide cable/conductor support per NEC.
- P. Color Code: Color code all service, feeder and branch circuit wires as follows:
 - 1. 120/208 Volts: Phase A (Black); Phase B (Red); Phase C (Blue), Neutral (White).
 - 2. 277/480 Volts: Phase A (Brown); Phase B (Orange); Phase C (Yellow), Neutral (Gray).
 - 3. Equipment Grounding Conductors: Green.

3.9 TYPE "MC" CABLE INSTALLATION

- A. General: Run cables neatly, primarily parallel and perpendicular to walls, ceilings and structural members, not diagonally. Securely strap cables in place at intervals not exceeding NEC requirements. Run cables neatly together along common routes where possible. Do not droop or lay cables on ceilings, or run loosely through building construction.

3.10 WIRING DEVICES AND COVERPLATES

- A. Switches: Locate switches in accessible locations near room/space entry point(s). Install single-pole and double-pole switches so that the circuit is on when the switch handle is up.
- B. Lighted Handle Switches: Provide lighted handle switches for all light switches in mechanical rooms, electrical rooms, crawl spaces, elevator pits, etc.
- C. Receptacles: Install receptacles with ground pin down when mounted vertically.
- D. GFCI Receptacles: For each receptacle designated or indicated to be "GFCI", provide a GFCI type receptacle. Do not substitute general use receptacle with feed-thru GFCI protection from upstream GFI receptacle.

- E. Coverplates: Provide coverplate for each wiring device or group of devices. Where devices are shown adjacent (e.g. bank of light switches), mount all such adjacent devices under one multi-gang coverplate, unless indicated otherwise.

3.11 EQUIPMENT CONNECTIONS

- A. General: Connect complete, all equipment requiring electrical connections, furnished as part of this Contract or by others, unless indicated otherwise. Confirm exact equipment locations with trade furnishing and installing the respective equipment.
- B. Equipment Variations: Note that equipment sizes and capacities as shown on the Contract Documents are for bidding purposes and as such may not be the exact unit actually furnished. Contractor shall anticipate minor variations in equipment and shall include in his Bid all costs required to properly connect the equipment actually furnished.
- C. Verification: Obtain and review product data, shop drawings, and manufacturer's written installation instructions for equipment furnished by others. Examine actual equipment to verify proper connection locations and requirements.
- D. Coordination: Sequence electrical rough in and final connections to coordinate with the installation and start up schedule and work by other trades.
- E. Rough-In: Provide all required conduit, boxes, fittings, wire, connectors and miscellaneous accessories, etc. as necessary to rough-in and make final connections to all equipment requiring electrical connections.
- F. Motors and Equipment: In general, motors and motorized equipment shall be wired in conduit to a junction box (or safety switch) near the unit, and from there to the unit in liquid-tight flexible metal conduit.
- G. Connections: Provide properly sized overload and short circuit protection for all equipment connected, whether furnished under this Contract or by others. Verify proper connections with manufacturer's published diagrams and comply with same. Report any discrepancies between the Contract Documents and actual equipment requirements. Do not proceed with connections until resolved. Verify that equipment is ready for electrical connections, wiring and energization, prior to performing same.
- H. Control Wiring: Provide all control wiring to remote devices or equipment as indicated or required. Modify equipment control wiring, install or disconnect jumpers, etc. as required for proper operation of equipment.
- I. HVAC and Plumbing Systems Motors: Provide all required power wiring from indicated power source to each motor controller and from each motor controller to respective motor. Make all connections to motors and control equipment complete and leave

equipment in proper operating order. Connect power to motors for correct direction of rotation. Verify nameplate ratings of all motors. Report any deviations or discrepancies.

3.12 HANGERS AND SUPPORTS

- A. General: Rigidly support and secure all electrical materials, raceway and equipment to building structure using hangers, channels, supports and fasteners, suitable for the use, materials and loads encountered. Provide all necessary hardware.
- B. Overhead Mounting: Attach overhead mounted equipment to structural framework or supporting metal framework. Do not make attachments to steel roofing, steel flooring or ceiling tiles.
- C. Wall Mounting: Support wall mounted equipment by masonry, concrete block, metal framing or sub-framing.
- D. Exterior Building Walls: Mount all electrical equipment located on the interior of exterior building walls, at least 1/2" away from wall surface, using suitable spacers.
- E. Structural Members: Do not cut, drill or weld any structural member except as specifically approved by the Architect/Engineer.
- F. Independent Support: Do not support electrical materials or equipment from other equipment, ductwork or supports for same.
- G. Raceway Support: Rigidly support all raceway with maximum spacings per NEC, and so as to prevent distortion of alignment during pulling operation. Use approved hangers, clamps and straps for individual raceway runs. Do not use perforated straps or tie wires. Where multiple parallel raceways are run together, use trapeze type hanger arrangement made from U-channel and accessories, suspended by threaded rods, and allow at least 25% spare capacity for future installation of additional raceways. Rigidly anchor vertical conduits serving floor-mounted or "island" type equipment mounted away from walls with metal bracket or rigid steel conduit extension secured to floor.
- H. Miscellaneous Supports: Provide any additional structural support steel brackets, angles, fasteners and hardware as required to adequately support all electrical materials and equipment.

3.13 EQUIPMENT MOUNTING HEIGHTS

- A. General: As indicated.
- B. Where structural or other interferences prevent compliance with mounting heights listed above, consult Architect/Engineer for approval to change location before installation.

3.14 ELECTRICAL IDENTIFICATION

- A. General: Locate nameplate, marking or other identification means on outside of front covers when above ceilings, in equipment rooms, and when in other unfinished areas. Locate on backside of front cover when in finished rooms/areas. Use Contract Document designations for identification legends unless indicated otherwise.
- B. NEC Required Identification: Provide all equipment identification, warning signs, etc. as required by the NEC.
- C. Manufacturer Supplied Equipment Nameplates: Provide equipment nameplates and markings, with all information as required by NEMA and UL.
- D. Nameplates: Provide an engraved nameplate (with minimum height characters indicated) for each of the following:
 - 1. Switchboards, meter centers, distribution panels and motor control centers- (1/2" H). Indicate equipment name and voltage, phases and wires.
 - 2. Overcurrent devices, and all other devices mounted in any of the above - (5/16" H).
 - 3. Branch circuit panelboards, safety switches, motor controllers and drives, individually mounted circuit breakers, transformers, relay enclosures, and miscellaneous electrical cabinets - (5/16" H). Indicate equipment name (or load served) and voltage, phases and wires.
 - 4. Motor control stations, and toggle switches located remote from load served, or where function is not readily evident - (3/16" H).
 - 5. Communications and special system cabinets - (5/16" H).
 - 6. HVAC Equipment and Separately Mounted Switches and Controllers for Same:
For each piece of HVAC equipment and controller, provide label tape indicating respective panelboard and circuit numbers(s) serving the equipment. Locate on each safety switch or controller serving the equipment where applicable, and also on unit itself in location obviously conspicuous to service/operating personnel.
- E. Marking Pen Labeling: Mark each junction and pull box indicating source designation and circuit number(s) for the enclosed conductors.
- F. Wire Tags: Apply wire tag indicating appropriate circuit or feeder number to each conductor present in panelboard gutters, and to each conductor in pull and junction boxes where more than one feeder or multi wire branch circuit is present. Where only a single feeder or multi wire branch circuit is present, box cover labeling and conductor color coding is sufficient. For control, communications and signal circuits, apply wire tag indicating circuit or termination number at all terminations and at all intermediate locations and boxes where more than one circuit is present.

- G. Panelboard Circuit Directories: For each new panelboard and each existing panelboard where any circuit modifications are made, provide and accurately complete a new circuit directory card in typewritten form, identifying load served or "spare" or "space" for each circuit pole space. Use actual Owner designated room numbers or names (not construction room numbers or designations)
- H. Wiring Devices: Using adhesive backed printed tape, label each wiring device coverplate, indicating respective panel designation and circuit number serving the device. Attach tape label to outside of device coverplate.

3.15 GROUNDING

- A. General: Provide all system and equipment grounding and bonding as indicated and as required by the NEC.
- B. Equipment Grounding: Provide a green equipment grounding conductor, sized per NEC (larger if so indicated) with each feeder and branch circuit run.

3.16 SAFETY SWITCHES

- A. Mounting: Mount safety switches where indicated, and on wall or column adjacent to unit served, or directly to unit or supporting framework where applicable, indicated or required.
- B. Connections: Make all indicated/required electrical connections.

3.17 PANELBOARDS AND CIRCUIT BREAKERS

- A. General: Secure panelboard rough-in boxes to building structure or steel framing, independent of conduits. Install with top of box per NEC restrictions. Make all indicated and required feeder and branch circuit connections. Neatly train and tie all wiring within panelboard enclosure.
- B. Cover all unused overcurrent protective device spaces.
- C. Removals: Remove existing panelboards as indicated.
- D. Existing Panelboards to Remain: Remove existing breakers, provide new breakers, add/revise circuiting, etc. as indicated and required.

3.18 LIGHTING FIXTURES

- A. General: Install lighting fixtures as described in the Lighting Fixture Schedule, complete with LED or other indicated lamps, and drivers/ballasts. Provide all necessary accessory fittings, hangers, stems, clamps, brackets, yokes, plaster flanges, outlet boxes, and

miscellaneous devices required for a complete installation as recommended by the fixture manufacturer.

- B. Quantity: Per Electrical Drawings.
- C. Locations: General locations per Electrical Drawings, exact locations per Architectural reflected ceiling plans, interior and exterior elevations, and details. Architect reserves the right to field direct the exact location for all decorative fixtures in public spaces.
- D. Mounting and Support: Securely support and/or suspend all lighting fixtures from structural members of building.
- E. Mounting Heights: Suspend pendant mounted lighting fixtures at heights indicated, measured from finished floor to bottom of fixture enclosure or reflector unless noted otherwise. Install wall mounted fixtures at heights indicated measured from finished floor to center of fixture outlet box unless noted otherwise.
- F. Recessed Lighting Fixtures: Provide flexible connections to all recessed lighting fixtures as required by the NEC and in accordance with approved wiring methods. Secure fixtures to the ceiling framing members per NEC. Secure troffers to ceiling tees twice along each long side of troffer.
- G. Lamps: Install specified lamps as recommended by the lamp and lighting fixture manufacturers. Follow lamp manufacturer's recommendations for handling and installing lamps.
- H. Defective LED's, Lamps and Drivers/Ballasts: Replace all burned out, defective and inoperative LED's and lamps, and all noisy, defective and inoperative drivers/ballasts, prior to Owner's acceptance.

3.19 SPARE PARTS

- A. General: Deliver specified spare part to Owner and obtain receipt for spare parts.

3.20 CONDUCTOR TESTS

- A. Branch Circuits: Test during installation for continuity and identification and perform operational tests to determine that all circuits perform the function for which they are intended.
- B. Feeder Conductors: For all feeder conductors rated 600 volts or less, provide "Megger" insulation test prior to energizing, using a 1,000-volt motor driven megger. Apply test voltage until readings reach a constant value, and until three equal readings, each one minute apart, are obtained. Minimum megger reading shall be 45 megohms for feeder

conductors. Document test results and submit for approval prior to energizing
conductors.

END OF SECTION 260501

SECTION 260921 - LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. General: Provide lighting control equipment, devices and wiring as indicated.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's cut sheets and descriptive literature for equipment and devices to be used on the Project, indicating compliance with the specifications. Include typical wiring diagrams.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROLS- GENERAL

- A. General: System providing distributed occupancy sensor on-off control, manual dimming and/or on-off control via lighting power packs and associated devices, for interior lighting fixtures as indicated.
- B. Type of Controls: All low voltage controlled circuits to include the indicated automatic and/or manual controls. Provide lighting power packs, remote switches/dimmers, occupancy sensors, control modules, etc. as indicated.
- C. Dimming: All dimming controls to be 0-10VDC. For each circuit with dimming control, provide definite contact-break on-off control as well, via lighting power pack.
- D. Network: All lighting power packs and control devices to be connected via separate dedicated Cat-5 Ethernet cabling system.
- E. Complete: Provide all necessary components and wiring as required for the specified and indicated control and control sequences.

2.2 ACCEPTABLE MANUFACTURERS

- A. Acuity Controls "nLight"; or approved equal.

2.3 LIGHTING CONTROLS

- A. Device Colors: Match Project general wiring device color (Light Almond). Confirm with Architect.

- B. Device Legends: Custom engraved identification for each button for each station as assigned/directed by Engineer.
- C. On-Off Switches: Acuity Controls #nPODMA-color.
- D. Double On-Off Switches: Acuity Controls #nPODMA-2P-color.
- E. Quad On-Off Switches: Acuity Controls #nPODMA-4P-color. With custom engraved switch legends as indicated or directed.
- F. On-Off Plus 0-10V Dimmer Switches: Acuity Controls #nPODMA-DX-color.
- G. Double On-Off Plus 0-10V Dimmer Switches: Acuity Controls #nPODMA-2P-DX-color.
- H. Quad On-Off Plus 0-10V Dimmer Switches: Acuity Controls #nPODMA-4P-DX-color. With custom engraved switch legends as indicated or directed.
- I. Four-Scene Preset Stations with On-Off and Raise-Lower: Acuity Controls #nPODMA-4SB-DX-color.
- J. Digital Dimming Touch Screen Time Clocks: Acuity Controls #nDTC series.
- K. Occupancy Sensor Wall Switches with 0-10V Dimmer: Acuity Controls #nWSX-LV-DX.
- L. Occupancy Sensor Wall Switches: Acuity Controls #nWSX-LV.
- M. Ceiling Mounted Occupancy Sensors: Acuity Controls #nCM-9-RJB.
- N. Corner Mounted Occupancy Sensors: Acuity Controls #nWV-16-KIT.
- O. Lighting Power Packs: Acuity Controls #nPP16-EFP.
- P. Lighting Power Packs for 0-10V Dimming: Acuity Controls #nPP16-D-EFP.
- Q. Control Cables Between nLight Devices: Cat-5E, pre-terminated with non-booted connectors, plenum-rated. Acuity Controls #CAT5 series.
- R. Control Cables for 0-10V Diming Circuits to Lighting Fixtures: Class II, size as required, plenum-rated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install all equipment as recommended by the equipment manufacturer. Use only one manufacturer for all devices and equipment described in this Section.

- B. Connections: Install and connect all devices to each other and to all respective controlled lighting fixtures per the manufacturer's written instructions and for the indicated operation and control. Extend 0-10VDC dimming control wiring from each lighting dimming power pack to all its respective dimmed lighting fixtures.
- C. Programming and Setting Adjustments: Program each device/equipment requiring same. Adjust field of views, sensitivities and time delays as required for optimum control.
- D. Control Wiring: Provide all necessary control wiring for total and satisfactory system operation. Low voltage control wiring may be run without conduit above suspended ceilings. Neatly support and secure cables to building structure above ceiling. Provide conduit protection wherever cables penetrate fire barriers, are exposed or susceptible to damage.

3.2 OCCUPANCY SENSOR WALL SWITCHES AND OCCUPANCY SENSORS

- A. Locations: Install sensors in the general locations indicated. Adjust exact locations if required to comply with manufacturer's recommendations for optimum placement and control.
- B. Operation: In general, all general illumination lighting fixtures in a room (or area) are to be controlled by the sensor(s) in the same room (area). Lights shall remain on as long as at least one sensor in room detects occupancy. When occupancy is no longer detected, lights to turn off after set time delay

3.3 LOW VOLTAGE MANUAL CONTROLS

- A. Low Voltage Switches and Dimming Control Switches: Install where indicated, and connect and program for the indicated control.

3.4 TESTS

- A. General: Test all equipment and devices for proper operation. Correct/adjust as required.

3.5 OWNER INSTRUCTION

- A. General: Instruct the owner's representative(s) (minimum one one-hour session) in the operation and maintenance of each type of equipment and device, to the Owner's satisfaction.

END OF SECTION 260921

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SECTION 265001 - LIGHTING FIXTURE SCHEDULE

* MANUFACTURERS AND MODELS/NUMBERS LISTED ARE TO ESTABLISH TYPE, QUALITY AND PERFORMANCE.

COMPETING MANUFACTURERS/MODELS/NUMBERS WILL BE ACCEPTED IF OF EQUAL OR COMPARABLE TYPE, CONSTRUCTION, QUALITY, PERFORMANCE AND DETAIL.

ALL MOUNTING OPTIONS AND FINISH COLORS TO BE CONFIRMED WITH ARCHITECT.

TYPE	DESCRIPTION	MOUNTING	LAMPING	BALLAST(S)/ DRIVER(S)	VOLTS	MANUFACTURER SERIES & NO. *	NOTES
A1	<u>LED CONTEMPORARY TROFFER</u> : 2' X 2', STEEL HOUSING, PLASTIC END CAPS, CURVED HOURGLASS SMOOTH LOW GLARE ACRYLIC LENS WITH CENTER SPINE, IP5X RATED SEALED OPTICS, WHITE FINISH	RECESSED LAY-IN CEILING	LED'S 3500K, 80 CRI 3319 LUMENS 110 LUMENS/WATT L80 @ 60,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING 30W	120-277V	LITHONIA LIGHTING "ENVEX" #ENVX-2X2-HRGC-3300LM-35K- MIN1-ZT-MVOLT	OFFICES
A2	<u>LED CONTEMPORARY TROFFER</u> : 2' X 2', STEEL HOUSING, PLASTIC END CAPS, CURVED HOURGLASS SMOOTH LOW GLARE ACRYLIC LENS WITH CENTER SPINE, IP5X RATED SEALED OPTICS, WHITE FINISH	RECESSED LAY-IN CEILING	LED'S 3500K, 80 CRI 1914 LUMENS 110 LUMENS/WATT L80 @ 60,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING 17W	120-277V	LITHONIA LIGHTING "ENVEX" #ENVX-2X2-HRGC-2000LM-35K- MIN1-ZT-MVOLT	CORRIDORS, TOILETS, MISC.
A3	<u>LED AMBIENT TROFFER</u> : 2' x 2', EXTRUDED ALUMINUM HOUSING AND CENTRAL HOUSING, SPECULAR ALUMINUM REFLECTORS, GREY 35-DEGREE MIKROLITE CENTER OPTICS ON SEPARATE SECOND CIRCUIT	RECESSED LAY-IN CEILING	LED'S 3500K, 90 CRI 3,000 LUMENS 92 LUMENS/ WATT L85 AT 50,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING 33W	120-277V	AXIS / BALANCED CARE "FLEXIBLE AMBIENT 2X2" #BCFA-22-3200-90-35-GD- CO(MKL35-GR)-W-UNV-DP-2-TB15	COMPUTER LAB
B1	<u>LED WET LABEL TROFFER</u> : 2' X 2', 20-GAUGE STEEL HOUSING, 16-GAUGE OVERLAPPING ALUMINUM DOOR FRAME, 0.125" THICK FROSTED ACRYLIC LENS, MEDIUM DISTRIBUTION, GASKETING BETWEEN DOOR FRAME AND LENS AND BETWEEN DOOR AND FRAME, UL WET LABEL, WHITE POWDERCOAT FINISH	RECESSED LAY-IN CEILING	LED'S 3500K, 80 CRI 2,000 LUMENS 91 LUMENS/ WATT L70 AT 100,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING ~22W	120-277V	LITHONIA "WRTL" #2WRTL-G-L24-2000LM-OAW-AFL- MD-MVOLT-GZ1-35K-80CRI-WH	NR HS EXTERIOR ENTRY

TYPE	DESCRIPTION	MOUNTING	LAMPING	BALLAST(S)/ DRIVER(S)	VOLTS	MANUFACTURER SERIES & NO. *	NOTES
D1	LED ROUND DOWNLIGHT: 6" DIAMETER X 4.75" HIGH, 16-GAUGE STEEL AND LEXAN CONSTRUCTION, SHATTERPROOF ACRYLIC 1.1" REGRESSED BEZEL WITH DIFFUSED LENS, 60-DEGREE BEAM OPTICS, WHITE BEZEL AND TRIM, UL DAMP LABEL	RECESSED CEILING	LED'S 3500K, 80 CRI 1660 LUMENS 97 LUMENS/WATT L70 @ 66,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING 17W	120-277V	ALPHABET "NU6" #NU6-RD-SW-20LM-35K-80-HHE60- WH-WH-RET-120-DIM10-EM12	VESTIBULES, MISC.
E1	LED RECESSED CEILING EMERGENCY LIGHTING UNIT: 10" X 6" RECTANGULAR TRIM, HIGH IMPACT UV-STABLE THERMOPLASTIC HOUSING, FOUR INTEGRATED ADJUSTABLE LED HEADS, 4.8V 90-MINUTE NICKEL METAL HYDRIDE BATTERY, SELF-DIAGNOSTICS, TEXTURED WHITE FINISH	RECESSED CEILING	4- 1W LED LAMP HEADS	INTEGRAL DRIVER(S) 4W	120/277V	ISOLITE "ELF" #ELF-4W-WH-MRC-SD-RECT	GENERAL USE
E2	LED EMERGENCY LIGHTING UNIT: 12" WIDE X 5" HIGH X 4" DEEP, FLAME RATED MOLDED ABS THERMOPLASTIC HOUSING, EXTRUDED ALUMINUM LED HEAT SINKS, TWIN ADJUSTABLE LED LAMP-HEADS, 90-MINUTE LITHIUM IRON PHOSPHATE BATTERY, BROWNOUT DETECTION, LOW VOLTAGE DISCONNECT, SELF-DIAGNOSTICS	SURFACE WALL	2- 6W LED LAMP HEADS 650 LUMENS EACH	INTEGRAL DRIVER 6W	120/277V	ISOLITE "BUG" #BUG-6W-WH-MB-SD	EQUIP. ROOMS, MISC.USE

TYPE	DESCRIPTION	MOUNTING	LAMPING	BALLAST(S)/ DRIVER(S)	VOLTS	MANUFACTURER SERIES & NO. *	NOTES
F1	<u>LED LINEAR STRIP LIGHT</u> : 4' LONG X 5.3" WIDE X 4.0" DEEP, STEEL CHANNEL AND COVER, INJECTION MOLDED END CAPS, WIDE DIFFUSE ACRYLIC LENS WITH 12% UPLIGHT, CHAIN HANGERS, BAKED WHITE ENAMEL FINISH	CHAIN SUSPEND	LED'S 3500K, 80 CRI 3000 DELIV. LUMENS 150 LUMENS/WATT L70 @ 100,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING 20W	120-277V	LITHONIA LIGHTING "CLX" #CLX-L48-SEF-WDL-WD-120- MVOLT-GZ1-35K-80CRI-WH-HC36	CLOSETS, MISC.
G1E	<u>LED ROUND DOWNLIGHT</u> : 6" DIAMETER X 4.75" HIGH, 16-GAUGE STEEL AND LEXAN CONSTRUCTION, SHATTERPROOF ACRYLIC 1.1" REGRESSED BEZEL WITH DIFFUSED LENS, 60-DEGREE BEAM OPTICS, WHITE BEZEL AND TRIM, UL WET LABEL COLD WEATHER EMERGENCY BATTERY BACK-UP	RECESSED CEILING	LED'S 3500K, 80 CRI 1660 LUMENS 97 LUMENS/WATT L70 @ 66,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING 17W	120-277V	ALPHABET "NU6" #NU6-RD-SW-20LM-35K-80-HHE60- WH-WH-RET-120-DIM10-EM12	EXTERIOR SOFFITS
H1 H1E	<u>LED ROUND SHALLOW DRUM</u> : 15" DIAMETER X 2.5" HIGH, HEAVY GAUGE ALUMINUM TRIM, WHITE ALUMINUM PAN, OPAL ACRYLIC IFFUSER, WHITE FINISH, UL DAMP LABEL H1E: ADD REMOTE COLD WEATHER EMERGENCY BATTERY BACK-UP	SURFACE CEILING	LED'S 3500K, 80 CRI 2000 LUMENS 100 LUMENS/WATT L70 @ 60,000 HOURS	INTEGRAL DRIVER 0-10V, 1% DIMMING ~20W	120-277V	ECLIPSE LIGHTING "SONIC" H1: #SC-M-LED20-35K-80CRI-UNV- WH-SM H1E: ADD-REL10W-CW	EXTERIOR ENTRY SOFFITS

TYPE	DESCRIPTION	MOUNTING	LAMPING	BALLAST(S)/ DRIVER(S)	VOLTS	MANUFACTURER SERIES & NO. *	NOTES
X1	<u>LED EXIT SIGN</u> : SINGLE-FACE, DIECAST ALUMINUM HOUSING AND FACEPLATE, STENCIL FACE W/ 6" HIGH RED LETTERS, TEXTURED WHITE FINISH, ARROWS PER PLANS, 4-HOUR NICKEL METAL HYDRIDE BATTERY BACK-UP, BROWNOUT DETECTION, LOW VOLTAGE DISCONNECT, SELF-DIAGNOSTICS	UNIVERSAL	RED LED'S 10-YEAR LIFE	INTEGRAL DRIVER 2.4W	120/277V	ISOLITE "TL2" #TL2-EM-R-1-WH-MTEB-SD	GENERAL USE
X2	<u>LED EXIT SIGN</u> : DOUBLE-FACE, DIECAST ALUMINUM HOUSING AND FACEPLATES, STENCIL FACES W/ 6" HIGH RED LETTERS, TEXTURED WHITE FINISH, ARROWS PER PLANS, 4-HOUR NICKEL METAL HYDRIDE BATTERY BACK-UP, BROWNOUT DETECTION, LOW VOLTAGE DISCONNECT, SELF-DIAGNOSTICS	UNIVERSAL	RED LED'S 10-YEAR LIFE	INTEGRAL DRIVER 2.4W	120/277V	ISOLITE "TL2" #TL2-EM-R-2-WH-MTEB-SD	GENERAL USE

END OF SECTION 265001

LIGHTING FIXTURE SCHEDULE

265001 - 4

SECTION 270010 - BASIC COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Basic administrative and procedural requirements, and general requirements for communications work, applicable to all Division 27 work.

1.2 GENERAL

- A. Comply with 260010- Basic Electrical Requirements.

END OF SECTION 270010

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SECTION 270050 – GENERAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements, and basic materials and methods applicable for all Division 27 work. Limited scope general construction materials and methods for application with communications installations are also included.

1.2 GENERAL

- A. Comply with 260050- General Materials and Methods.
- B. Comply with 260501- Electrical Materials and Equipment.

END OF SECTION 270050

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SECTION 271001 - TELECOM CABLING SYSTEMS- PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. The following systems or portions of systems may be depicted or partially depicted on the Drawings but are to be provided separately by the Owner (except as indicated otherwise).

- 1. Telecommunications Cabling System (Patch Panels, Cables, Jacks, Coverplates).

- B. Exception: Do provide telecom jacks and cables under this Division 27 where so specified below and/or indicated on the Drawings.

1.2 SCOPE OF WORK BY DIVISION 26, 27

- A. 120 Volt Power: As indicated and required for each above system. Confirm with Owner for requirements not shown.
- B. Outlet/Back Boxes and Conduit Stubs: As indicated on Drawings and as indicated herein.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduits, Outlet Boxes, Conductors: Per 260501- Electrical Materials and Equipment.

2.2 TELECOM JACKS AND CABLES

- A. General: Match existing Cat-6 telecom jacks and Cat-6 telecom cables, on a per School basis.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordination: Coordinate and cooperate with the Owner (and Owner's selected Contractors) while performing Division 26, 27 work in same areas requiring "By Owner" work for the above systems. Take care not to damage devices, equipment and wiring for these systems. Perform Division 26, 27 work in such a way to allow reasonable concurrent or subsequent installation of the above systems by the Owner or the Owner's selected Contractors.

- B. 120 Volt Power: Provide all 120 volt power connections and receptacles for the above systems as indicated, and as reasonably anticipated/required by the Owner or Owner's selected Contractor where not indicated. Confirm with Owner or Owner's selected Contractor as to where hardwired connection(s) or receptacle(s) are required and provide accordingly.
- C. Service and Miscellaneous Conduits: Provide as indicated.

3.2 SYSTEMS DEVICES

- A. Systems Ceiling Mounted Devices: Are shown for reference and coordination purposes only. Rough-in and installation of all ceiling mounted devices will be provided by the Owner or Owner's selected contractor(s).
- B. Systems Wall Mounted Devices: In general, provide an outlet or back box and conduit stub for each indicated wall mounted device of the above systems.
- C. Telecom Outlet Boxes: Unless indicated or directed otherwise, recessed, 4" square by 2-1/2" deep, with flush single-gang extension ring. (Prior to commencing work, check with the Owner and the Owner's selected Contractor(s) for the above systems to determine any special outlet/back box requirements, differing from this specified standard outlet box. If larger or special boxes are required, provide accordingly.)
- D. Telecom Conduit Stubs: Minimum 1" EMT, from outlet/back box to accessible ceiling space. For rooms with hard ceilings, extend conduit stub horizontally in ceiling space to nearest room/corridor with an accessible (lay-in) ceiling. For floor and boxes in low height partitions, provide below floor conduit and/or conduit run horizontally in low height partition to nearest full height wall, and then rise through wall up to accessible ceiling space
- E. Conduit Stub Ends: Ream and bush each conduit end.
 - 1. Pull Strings: Provide a nylon pull string for each conduit stub, and secure at each end.

3.3 TELECOM JACKS AND CABLES

- A. General: Where so indicated (e.g. for relocated existing telecom outlets), provide Cat-6 telecom jacks and Cat-6 telecom cables to match existing, on a per School basis. Install and test each jack and cable per generally accepted industry standards. For each new jack, provide ID label to match existing labels, on a per School basis.

END OF SECTION 271001

SECTION 275111 - EXISTING PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Description of Work: At each School, modify and expand the existing school communication system as indicated. New equipment to include: central equipment components, speakers; volume controls; back boxes; conduit and wiring; and all miscellaneous appurtenances as required for a complete system.
- B. Removals: Remove certain existing school communication systems speakers in renovation areas as indicated, and salvage to Owner or relocate and reuse, as indicated.

1.2 REFERENCE STANDARDS

- A. All equipment to comply with the latest applicable requirements and standards of NFPA 70, UL 50, the Electronics Industries Association (EIA), and the Federal Communications Commission (FCC).

1.3 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for each type of device or equipment to be used on the Project.
- B. Shop Drawings:
 - 1. Complete description and layout of modifications to central equipment rack, clearly indicating all components (if needed).
 - 2. Complete wiring diagram, specifically for this Project, clearly indicating all new/reused speakers, devices and equipment and all interconnecting wiring types and quantities. Show all termination points at central equipment rack.
 - 3. Written description of system operation clearly indicating all system features, options, etc.
- C. Record Drawings: Include with the operation and maintenance data, a complete set of record drawings indicating all equipment, speakers, devices and cables, all accurate per as-built conditions.

1.4 GUARANTEE

- A. Manufacturer's Warranty: Including all parts, labor and travel to replace defective materials and workmanship, for a period of two years.

1.5 COMMUNICATION SYSTEMS CONTRACTOR

- A. The communication system shall be furnished by and installed under the direction of a qualified Communication System Contractor experienced in the installation, testing and adjusting of communications systems similar to the system specified herein.
- B. The Communication System Contractor shall be an authorized dealer for the existing system and new equipment furnished, shall have a minimum of five year's experience in communications systems installation, and shall guarantee daily on-call service, with response time no more than twelve hours, at the Project Site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. General: Match existing manufacturer(s), per School.

2.2 SYSTEM DESCRIPTION

- A. General: Complete, integrated communications system, providing intercom, and selective and all-call program distribution, and public address facilities throughout the building as indicated.

2.3 INTERCOM AND PUBLIC ADDRESS SYSTEM

- A. Design: Multi-channel, microprocessor-based, programmable administrative communications system, of modular construction, using plug-in connections between modules.
- B. System Capacities:
 - 1. Zones: Expand existing system if required to accommodate all new speaker zones.
 - 2. Paging Zones: (Existing to remain).
- C. Terminations: Punchdown blocks for all field wiring terminations.

2.4 INTERCOM AND PUBLIC ADDRESS SYSTEM CENTRAL EQUIPMENT

- A. General: Modify and expand the central equipment as required to accommodate the new speaker zones. New equipment to include the necessary power supplies, card cages, central control unit components, logic, switching and interface cards, amplifiers, termination boards, and all other components necessary for a complete system.
- B. Existing Equipment Rack: Modify/add as required.
- C. Rack Mount Kits: Provide rack mount kit for each new piece of equipment housed in equipment rack.
- D. Control Components: Digital cards, analog cards, switching cards, telephone interface cards, etc. as required to accommodate system expansion.
- E. Power Amplifiers: Add if required to satisfactorily power all new and existing system speakers and speaker horns simultaneously, with at least 30% spare capacity. Modular power amplifier, 120 or 250 watts RMS power output, less than 2% total harmonic distortion at rated load, frequency response of 30 to 20 Khz +/- 1 dB, output regulation better than 2dB from no load to full load, with built-in protection circuitry, and required outputs.

2.5 ADMINISTRATIVE CONTROL CONSOLES (TYPE "AC")

- A. General: Existing at each building to remain.

2.6 SPEAKERS

- A. Quantity: Per Drawings: Also provide (2) spares for each building.
- B. General: Assembly with speaker, transformer, back box, baffle and mounting supports. Confirm new speakers are compatible with existing system.
- C. Speaker: 8" diameter, dual cone, wide angle sound dispersion, 15-watt power rating, frequency response 60-15,000 Hz, with ceramic magnet and 1" voice coil. Include universal dual voltage line matching transformer, frequency response +/- 1.5 dB from 100-10,000 Hz, with 0.5, 1, 2 and 5 watt taps.
- D. Back Boxes: Nominally 12" diameter round steel housing, suitable for flush mounting 8" diameter speakers, acoustically treated with undercoating and patch jute lining.
- E. Baffles: Nominally 12" round for 8" diameter speakers, steel with beveled edge, screw mount, and baked white semi-gloss enamel finish.

- F. Mounting/Support: Provide all necessary supports, hardware, etc. For each speaker back box to be installed in a "lay-in" type ceiling, provide a T-bar bridge (or equivalent) for distributing weight to T-bar members.

2.7 VOLUME CONTROLS

- A. Quantity: Per Drawings. Also provide (5) spares.
- B. Ten-step auto-transformer type with 3 Db per step and positive "off" position, power handling capability of at least 10 watts, higher where required by number of speakers controlled, and with stainless steel faceplate with engraved dial scale.

2.8 MICROPHONES

- A. (Existing at each building to remain).

2.9 TERMINAL BOARDS/CABINETS

- A. General: As required.

2.10 JUNCTION BOXES

- A. As required, clearly labeled with "PA".

2.11 WIRE/CABLE

- A. General: All final wire sizes, types and counts shall be as determined by the communications system contractor for proper system operation, subject to the following minimum requirements. All cables to be plenum rated.
- B. Speaker Cables: 2-wire, minimum 16 gauge, twisted, shielded.

PART 3 - EXECUTION

3.1 GENERAL

- A. Removals: Remove existing speakers in renovation areas as indicated, and salvage to the Owner. Remove all associated wiring.

- B. Installation: Install, wire and connect all devices and equipment per manufacturers' written instructions and for satisfactory operation. Permanently identify all operating controls, switches, outlets, terminals, connections, etc.

3.2 ADMINISTRATIVE CONSOLES AND MICROPHONES

- A. (Existing to remain).

3.3 SPEAKERS

- A. General: Install all speakers for a secure and vibration free installation. Provide all necessary mounting hardware. Use T-bar bridge for all speakers installed in "lay-in" ceilings. Test each speaker line for proper impedance match before connecting to amplifiers.
- B. Suggested Initial Tap Settings:
 - 1. Corridors: 1.0 watts.
 - 2. Classrooms and Offices: 0.5 watts.
 - 3. (Or as recommended by Communication System Contractor).
- C. Final Tap Settings: Adjust speaker transformer taps from initial tap settings as required for proper audio level, under actual occupancy conditions.

3.4 WIRING

- A. General: Provide all speaker and miscellaneous cables as required for a complete and fully operational system.
- B. Speaker Zones: Provide separate speaker zone homerun cable for each speaker (generally one speaker per room), except where two or more speakers in same room are shown or indicated connected in which case the speakers shown connected shall be wired as one zone.
- C. Cable Installation: Cable may be run without raceway when concealed within interior building construction. Run communication system cables together in groups, and away from other electrical lines as much as possible. Install cables neatly, in straight lines parallel and perpendicular to building lines. Neatly support and secure all cables to building structure (do not droop cables). Fasten cables at least every 5 feet and within 12 inches of speaker and outlet boxes. All cables to be continuous without splice. Where cable(s) penetrate fire rated barriers, would be left exposed or susceptible to damage, install in raceway.

- D. Splices: Do not splice speaker cables.
- E. Existing Speakers Remaining: Maintain existing connections.

3.5 GROUNDING

- A. Effectively ground all equipment, and conductor and cable shields, to eliminate ground loops, noise pickup and other impairments.

3.6 CONNECTIONS TO TELEPHONE SYSTEMS AND SECURITY SYSTEMS

- A. (Existing to remain). All existing functionality to remain as is.

3.7 SPEAKER ZONE NUMBERING

- A. General: Number each speaker zone, using actual Owner designated room numbers (not construction drawing room numbers), as directed by the Owner.

3.8 SYSTEM CUSTOM PROGRAMMING

- A. Customization of the public address/intercom central equipment control logic, system option selections, station number assignments, station restrictions, etc. shall be performed by the Communication System Contractor so as to comply with all requirements of this section and the Owner's preferences, and shall be included in this contract as follows:
 - 1. Initial programming (for system start-up, as directed by the Architect/Engineer and/or Owner).
 - 2. Second programming (after Owner instruction and prior to final acceptance, as directed by the Architect/Engineer and/or Owner, to comply with the Owner's exact requirements).
 - 3. Third programming (to provide any Owner required or requested modifications, to be performed at any time during the two-year guarantee period, as requested by Owner).

3.9 TESTS AND ADJUSTMENTS

- A. General: The Communication System Contractor shall perform all necessary equalization settings and other adjustments as required for optimum operation of the system. The system shall be free from hums and rattles.

- B. Tests: Test each speaker for proper operation. Test each feature of the central equipment for proper operation. Final acceptance testing shall be performed in the presence of the Owner's representative(s) and/or Architect/Engineer, after all equalization settings, tap settings and other adjustments have been made.

END OF SECTION 275111

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SECTION 280010 - BASIC ELECTRONIC SAFETY AND SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Basic administrative and procedural requirements, and general requirements for electronic safety and security work, applicable to all Division 28 work.

1.2 GENERAL

- A. Comply with 260010- Basic Electrical Requirements.

END OF SECTION 280010

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SECTION 280050 – GENERAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements, and basic materials and methods applicable for all Division 28 work. Limited scope general construction materials and methods for application with electronic safety and security installations are also included.

1.2 GENERAL

- A. Comply with 260050- General Materials and Methods.
- B. Comply with 260501- Electrical Materials and Equipment.

END OF SECTION 280050

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SECTION 281001 - SECURITY SYSTEMS- PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. The following systems or portions of systems may be depicted or partially depicted on the Drawings but are to be provided separately by the Owner.
 - 1. Access Control Systems: (Credential Readers, Electric Door Locks, Door Contacts, etc.)
 - 2. Intrusion Detection Systems: (Door Contacts, Motion Detectors, Keypads, etc.).
 - 3. Video Surveillance Systems: (Video Surveillance Cameras, etc.).
 - 4. Emergency Systems: (Lockdown Pushbutton Stations, etc.)

1.2 SCOPE OF WORK BY DIVISION 26, 27

- A. 120 Volt Power: As indicated and required for each above system. Confirm with Owner for requirements not shown.
- B. Outlet/Back Boxes and Conduit Stubs: As indicated on Drawings and as indicated herein.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduits, Outlet Boxes, Conductors: Per 260501- Electrical Materials and Equipment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordination: Coordinate and cooperate with the Owner (and Owner's selected Contractors) while performing Division 26, 27 work in same areas requiring "By Owner" work for the above systems. Take care not to damage devices, equipment and wiring for these systems. Perform Division 26, 27 work in such a way to allow reasonable concurrent or subsequent installation of the above systems by the Owner or the Owner's selected Contractors.
- B. 120 Volt Power: Provide all 120 volt power connections and receptacles for the above systems as indicated, and as reasonably anticipated/required by the Owner or Owner's selected Contractor where not indicated. Confirm with Owner or Owner's selected

Contractor as to where hardwired connection(s) or receptacle(s) are required and provide accordingly.

- C. Miscellaneous Conduits: Provide as indicated.

3.2 SYSTEMS DEVICES

- A. Systems Ceiling Mounted Devices: Are shown for reference and coordination purposes only. Rough-in and installation of all ceiling mounted devices will be provided by the Owner or Owner's selected contractor(s).
- B. Systems Wall Mounted Devices: In general, provide an outlet or back box and conduit stub for each indicated wall mounted device of the above systems.
- C. Security System Device Outlet Boxes: Unless indicated or directed otherwise, recessed, 4" square by 2-1/2" deep, with flush single-gang extension ring. (Prior to commencing work, check with the Owner and the Owner's selected Contractor(s) for the above systems to determine any special outlet/back box requirements, differing from this specified standard outlet box. If larger or special boxes are required, provide accordingly.)
- D. Security System Device Conduit Stubs: Minimum 3/4" EMT, from outlet/back box to accessible ceiling space. For rooms with hard ceilings, extend conduit stub horizontally in ceiling space to nearest room/corridor with an accessible (lay-in) ceiling. For floor and boxes in low height partitions, provide below floor conduit and/or conduit run horizontally in low height partition to nearest full height wall, and then rise through wall up to accessible ceiling space
- E. Conduit Stub Ends: Ream and bush each conduit end.
 - 1. Pull Strings: Provide a nylon pull string for each conduit stub, and secure at each end.

END OF SECTION 281001

SECTION 284605 – EXISTING FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Description of Work: Modify existing multiplexed addressable fire alarm system as indicated. New equipment to include: control panel equipment (if required); manual and automatic alarm initiating devices; audible and visual alarm signaling devices; back boxes; conduit, wiring and cable; and all miscellaneous appurtenances as required for a complete system.
- B. Existing Systems to Remain (Field Verify Indicated Manufacturers):
 - 1. New Rochelle High School: Siemens "Fire Finder".
 - 2. Albert Leonard Middle School: Honeywell/Gamewell/FCI "E3 Series".
 - 3. Jefferson Elementary School: Honeywell/Gamewell/FCI "S3 Series"
 - 4. William B. Ward Elementary School: Edwards "EST3".
 - 5. George M. Davis Elementary School: Siemens "Cerberus Pro".

1.2 REFERENCE STANDARDS

- A. All equipment and the installation of same shall comply with the latest applicable standards of NFPA and U.L., and requirements of the local Fire Marshall.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for required all FACP components, each type of device or equipment, and wire/cable to be used on the project.
- B. Shop Drawings:
 - 1. Complete wiring diagram, specifically for this project, for each building, clearly indicating all new and existing alarm initiating, alarm signaling, and control circuits, connections to all fire alarm devices, other electrical systems, and all terminations at Fire Alarm Control Panel.
 - 2. Record Drawings: Include with the operation and maintenance data, a complete set of record drawings indicating all device and circuit numbers, cable types/sizes and routing, and wire counts, all accurate per as built conditions. Include locations for all end-of-line devices.

1.4 FIRE ALARM SYSTEM SUB-CONTRACTOR QUALIFICATIONS

- A. (At each School) fire alarm system shall be furnished and installed by an authorized dealer for the specified equipment, who shall have at least 10 years experience in the installation of similar systems. Sub-contractor shall hold a NYS license to install fire alarm systems and shall be NICET certified.
- B. Acceptable Fire Alarm Sub-Contractors: (As directed by the School).
- C. Manufacturer's and Installers Warranty: Including all parts, labor and travel to replace defective materials and workmanship, including batteries, for a period of two years.
- D. Warranty Call Response: During the warranty period, fire alarm system supplier/installer shall provide a 24/7 available telephone number for immediate service response.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Match existing manufacturer at each School; no substitutes.
- B. Fire Alarm Devices (General): Devices to match respective existing building units, or be newer compatible equivalents.

2.2 SYSTEM

- A. Overview: Control panel is 24 volt, microprocessor based, intelligent, individually addressable/programmable type, Style 4 (Class B) supervised. The system is capable of monitoring and controlling devices on an individual basis. Alarm and control functions to be as indicated in PART 5, and generally match existing.

2.3 FIRE ALARM CONTROL PANEL/ANNUNCIATOR (FACP)

- A. General: Existing to remain.

2.4 FIRE ALARM ANNUNCIATORS

- A. General: Existing to remain.

2.5 FIRE ALARM POWER SUPPLIES

- A. General: Existing to remain.

2.6 ADDRESSABLE INITIATING AND CONTROL DEVICES

- A. Types: Area and duct type smoke detectors, heat detectors, manual stations, relay modules, monitor modules, control modules, etc. For each duct type smoke detector,

provide sampling tube sized to its respective duct width, and include keyed remote test/reset station.

- B. General: Match existing. Provide suitable device mounting box.

2.7 ALARM NOTIFICATION DEVICES

- A. Types: Fire alarm horn/strobes and strobes.
- B. General: Match existing. Provide suitable device mounting box.

2.8 MAGNETIC DOOR HOLDERS

- A. General: Provide under Division 8, suitable for 24VAC, 24VDC and 120VAC (field verify voltage required at each school).

2.9 JUNCTION BOXES

- A. As required, and painted red, and marked with "FA".

2.10 WIRE/CABLE

- A. Low Voltage Cable: UL listed, approved for power limited fire protective signaling circuit application, NEC type FPLP, plenum rated, with red jacket. Conductors to be solid copper, color coded, minimum size #16 AWG for communication loop and initiating circuits, minimum size #14 AWG for alarm signaling circuits; larger if necessary to match existing.
- B. 120 Volt Wiring: Complying with 260501- Electrical Materials and Methods.
- C. Requirements: All wire/cable shall be the size and type (e.g. shielded or unshielded) as required by the manufacturer for proper system operation. Verify all wire/cable sizes, types, and quantity requirements with equipment manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation: Install, wire and connect all devices and equipment for satisfactory operation. All wiring at the FACP shall be in wiring harnesses and arranged for easy addition of future wiring. All wires and terminals shall be permanently identified.
- B. Removals: Remove existing fire alarm devices as indicated, and remove all associated wiring, and all other existing wiring no longer in use. Maintain existing system operation throughout the construction period.

3.2 INSTALLATION SUPERVISION

- A. Installation shall be under the supervision of the Fire Alarm Sub-Contractor until Owner acceptance.

3.3 WIRE/CABLE

- A. General: Provide all required system wiring as necessary to connect all new and relocated existing devices.
- B. Low Voltage Cable: May be run without raceway when concealed within interior building construction, unless raceway protection is necessary for proper system operation. Run fire alarm cables together in groups, and away from other electrical lines as much as possible. Neatly support and secure all cables to building structure (do not droop cables). Fasten cables at least every 5 feet and within 12 inches of outlet boxes. All splices to be made up in outlet or junction boxes. Exposed splices will not be permitted.
- C. Conduit Required: Where cable(s) are to be run on exposed ceiling structure, penetrate fire rated barriers, would otherwise be left exposed or susceptible to damage, install in specified raceway.
- D. 120 Volt Wiring: Comply with 260501- Electrical Materials and Methods.

3.4 FIRE ALARM DEVICES

- A. General: Provide as indicated. Connect each device to existing system (initiating/control loop or notification appliance circuit as applicable) as required. Confirm existing circuits have available spare capacity for added devices, taking into account devices being disconnected from the system. Notify Architect/Engineer accordingly.

3.5 FIRE ALARM RELAY MODULES

- A. Applications: E.g. for fan shut down, and magnetic door holder and smoke damper control.
- B. Location: Locate in outlet box near associated monitored device where possible (e.g. in accessible above-ceiling spaces). Do not locate in finished public spaces (e.g. corridors and lobbies).
- C. Connections: Connect to existing initiating/control loop and to respective controlled device as indicated or required.
- D. Fire Alarm Relay Modules for Fan Shutdown: Modules to shutdown respective fan unit on any building fire alarm condition.

- E. Fire Alarm Relay Modules for Door Holder and Smoke Damper: Modules to release doors or close smoke dampers upon any building fire alarm condition, unless existing system operation varies, in which case, match existing operation.

3.6 SYSTEM CUSTOM PROGRAMMING

- A. Customization of the FACP logic and programming, to incorporate new device identification labels and functions, display formats, etc. shall be performed by the manufacturer's representative so as to comply with all requirements of this section, and shall be included in the contract as follows:
 - 1. Initial programming (for system start up, as directed by the Architect/Engineer).
 - 2. Second programming (prior to final acceptance, as directed by the Architect/Engineer, to comply with the Owner's exact requirements).

3.7 SYSTEM TEST

- A. (By Fire Alarm Sub-Contractor). Perform a quality inspection of the final installation and in the presence of the installing contractor and Construction Manager, Owner and Architect/Engineer's representatives, perform a complete functional test of the system. Testing shall include:
 - 1. Verification of proper operation of existing FACP, FAA(s) relative to system, modifications/additions.
 - 2. Activation of each new alarm initiating device, and verification of associated auxiliary control functions on an individual device basis.
 - 3. Verification of proper operation of all alarm signaling circuit devices.
 - 4. Verification that all custom device labels, messages, etc., are correct.
- B. Obtain a written approval of satisfactory testing and provide a finalization report.

PART 4 - CIRCUIT REQUIREMENTS

4.1 SYSTEM CONFIGURATION

- A. General: All fire alarm devices/equipment shall be connected to the FACP as required for complete and proper operation, whether specifically indicated or not, including:
 - 1. Alarm Initiating Devices.
 - 2. Various controlled Devices.

4.2 FIRE ALARM INITIATING LOOPS

- A. General: Use existing loop serving project area. Confirm adequate capacity to do so.

4.3 FIRE ALARM NOTIFICATION CIRCUITS

- A. General: Use existing circuit(s) serving project area. Confirm adequate capacity to do so

4.4 120 VOLT FIRE ALARM CIRCUITS

- A. General: 120 volt circuits for fire alarm equipment to originate at dedicated circuits in indicated panelboard. Provide as indicated and required.

PART 5 - SYSTEM OPERATION REQUIREMENTS

5.1 GENERAL

- A. Confirm and comply with requirements of local Fire Marshall, the Owner, and the following. In general, maintain existing system operation.

5.2 INITIATING/CONTROL LOOPS

- A. General: Maintain existing system operation.

5.3 ALARM NOTIFICATION CIRCUITS

- A. General: Maintain existing system operation.

END OF SECTION 284605

SECTION 312000 – EXCAVATION AND FILL

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Preparing subgrades for structures, walks, pavements, grasses and plants.
 - 2. Subbase course for concrete slabs, walks and asphalt pavement.
 - 3. Excavating and backfilling trenches for utilities and structures.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 312319: Dewatering.

1.3 DEFINITIONS

- A. Earth Excavation: The removal of all surface and subsurface material not classified as rock as defined below.
- B. Unsatisfactory Soil: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction. Soil that may contain rock or gravel larger than 3 inches in any dimension, frozen materials, organic matter, vegetation, soft, nondurable particles, elongated particles or other deleterious matters.
- C. Contaminated Soil: Soil that may require specific disposal method/location as it may contain items such as but not limited to trace/detect chemical, oil or soft or loose bituminous asphalt tar.
- D. Construction Debris Soil: Soil containing debris, waste, rubbish, slag, cinders, ashes, metals, or other manmade or foreign materials.
- E. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which can be removed only by blasting operations, drilling, wedging, or use of pneumatic tools, and boulders with a volume greater than 1.0 cu yd. Concrete building foundations and concrete slabs, not indicated, with a volume greater than 1.0 cu yd shall be classified as rock.
 - 1. Limestone, sandstone, shale, granite, and similar material in a broken or weathered condition which can be removed with an excavator or backhoe

- equipped with a bucket with ripping teeth or any other style bucket shall be classified as earth excavation.
- 2. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.
- F. Unclassified Earth Excavation: The excavation and disposal of all surface and subsurface materials of any description necessary to perform the work of this contract. This will include:
 - 1. All soil deposits of any description both above and below groundwater levels. These may be naturally deposited or placed by previous construction operations.
- G. Subgrade Surface: Surface upon which subbase or topsoil is placed.
- H. Subbase: Select granular material or subbase course Type 2 which is placed immediately beneath pavement or concrete slabs.
- I. Maximum Density: The dry unit weight in pounds per cubic foot of the soil at "Optimum Moisture Content" when determined by ASTM D 698 (Standard Proctor), or ASTM D 1557 (Modified Proctor).
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Landscaped Areas: Areas not covered by structures, walks, roads, paving, or parking.
- L. Unauthorized Excavation: The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Engineer.
- M. Grading Limit Line (Shown on Drawings): Limits of grading, excavations and filling required for the work of this contract. Unless specifically noted otherwise, the Grading Limit Line and Contract Limit Line will be considered the same.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Filter Fabric: Manufacturer's catalog sheets, specifications, and installation instructions.
 - 2. Geogrid: Manufacturer's catalog sheets, specifications, and installation instructions.
- B. Quality Control Submittals:
 - 1. Subbase Materials: Material Test Reports: Classification according to ASTM D 2487, laboratory compaction curve according to ASTM D 1557 and certified gradation analysis according to ASTM C136 for each soil material proposed for fill and backfill. Name and location of source and the DOT Source Number.

2. Other Aggregates: Name and location of source and soil laboratory test results.

1.4 PROJECT CONDITIONS / COORDINATION AND SCHEDULING

A. Existing Utilities:

1. Coordinate the work to determine the extent of the areas of subsurface investigation required to locate all underground utilities and service connections in the areas of excavation.
2. Coordinate the work with the Owner and Engineer to minimize utility disruptions and facility operations. Provide a schedule for the Work required to the Owner and Engineer for approval. Upon approval of the schedule, notify the Owner and Engineer a minimum of three (3) working days prior to performing the Work.
3. Within the areas of excavation, all underground utilities and service connections shall be field-located and their locations marked at least two (2) weeks prior to the performance of the required excavation work.

B. Existing Conditions:

1. Protect existing trees and plants during performance of the work unless otherwise indicated. Box trees and plants indicated to remain within the grading limit line with temporary steel fencing or solidly constructed wood barricades as required. Protect root systems from smothering. Do not store excavated material, or allow vehicular traffic or parking within the branch drip line. Restrict foot traffic to prevent excessive compaction of soil over root systems.
2. Dewatering: Include the disposal of surface water and ground water, which may accumulate in open excavations, unfinished fills, or other low areas. Remove water by pumping, or other methods to prevent softening of exposed surfaces. Surface dewatering plan shall include the rerouting of any storm water runoff or natural drainage if necessary and shall comply with NYS DEC requirements.
3. Protection and Restoration of Surfaces: Protect newly graded areas from traffic, erosion, and settlements. Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance. Protect existing streams, ditches and storm drain inlets from water-borne soil by means of straw bale dikes. Conduct work in accordance with NYS DEC requirements.

C. Cold Weather Requirements:

1. Excavation: When freezing temperatures are anticipated, do not excavate to final required elevations for concrete work unless concrete can be placed immediately.
2. Backfilling: Do not backfill with any frozen soil materials.

D. Thru-traffic or fill placement with heavy construction vehicles or equipment which causes rutting or weaving to occur within the perimeter of a building will not be permitted. If rutting or weaving occurs during placement of fill, place specified fill in a stable area outside building perimeter and spread with tracked equipment to specified layer thickness.

1.5 DELIVERY AND STORAGE

- A. Deliver and store materials in a manner to prevent contamination or segregation.
- B. Protect filter fabric from sunlight during transportation and storage.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Routine testing of existing soils and compacted material for compliance with these Specifications shall be performed by a testing agency acceptable to Engineer.
- C. Compacted material that does not meet density requirements shall be removed and/or re-compacted, and retested.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Select Granular Fill Material: Stockpiled, sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
2 inch	50.0	100
No. 40	0.425	0-70
No. 200	0.075	0-15

- 1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after four test cycles.
- 2. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve will not exceed 5.0.
- 3. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a 1/2-inch sieve will consist of flat or elongated particles. A flat or elongated particle is defined as one which has its greatest dimension more than three times its least dimension.
- E. NYSDOT Subbase Course Type 2: Stockpiled, crushed ledge rock or approved blast furnace slag. Comply with the gradation and material requirements specified below:

Sieve	Percent Passing
-------	-----------------

Sieve Size	Size opening (mm)	
2 inch	50.0	100
1/4 inch	6.3	25-60
No. 40	0.425	5-40
No. 200	0.075	0-10

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after four test cycles.
 2. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve will not exceed 5.0.
 3. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a 1/2-inch sieve will consist of flat or elongated particles. A flat or elongated particle is defined as one which has its greatest dimension more than three times its least dimension.
- F. NYSDOT #1 Crushed Stone: Clean, durable, sharp-angled fragments of rock of uniform quality. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
1 inch	25.0	100
1/2 inch	12.5	90 – 100
1/4 inch	6.3	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.
- G. NYSDOT #2 Crushed Stone: Clean, durable, sharp-angled fragments of rock of uniform quality. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
1-1/2 inch	37.5	100
1 inch	25.0	90 – 100
1/2 inch	12.5	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.
- H. NYSDOT #1 Screened Gravel: Clean, durable gravel free from coatings. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
1 inch	25.0	100
1/2 inch	12.5	90 – 100
¼ inch	6.3	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.
- I. NYSDOT #2 Screened Gravel: Clean, durable gravel free from coatings. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
1-1/2 inch	37.5	100
1 inch	25.0	90 – 100
1/2 inch	12.5	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.
- J. Underdrain Filter Type 2 (NYSDOT 605.10, 733-2002): Material consisting of crushed stone, sand, gravel or screened gravel. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
1/2 inch	12.5	100
1/4 inch	6.3	20 – 100
No. 10	2.0	0-15
No. 20	.85	0-5

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after ten test cycles.
- K. Selected Borrow/Fill: Sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials. Comply with the gradation requirements specified below:

Sieve		Percent Passing
Sieve Size	Size opening (mm)	
4 inch	101.6	100
No. 40	0.425	0-70
No. 200	0.075	0-15

- L. Suitable Material (Fill and Backfill for Landscaped Areas): Material consisting of mineral soil (inorganic), blasted or broken rock and similar materials of natural or man-made origin, including mixtures thereof. Maximum particle size will not exceed 2/3 of the specified layer thickness prior to compaction. NOTE: Material containing cinders, industrial waste, sludge, building rubble, land fill, muck, and peat will be considered unsuitable for fill and backfill, except topsoil and organic silt may be used as suitable material in landscaped areas provided it is placed in the top layer of the subgrade surface.
- M. Flowable Fill: Shall consist of a mixture of Portland cement, sand, water and admixtures proportioned to provide a non-segregating, free-flowing, self-consolidating material that will result in a hardened, dense backfill.
 - 1. Shall have a 28-day compressive strength between 40 and 100 psi.

2.2 GEOTECHNICAL FABRIC

- A. Filter Fabric (GeoTextile):
 - 1. Pavement Section Geogrid: Tensar TriAx Geogrid or approved equivalent.
 - 2. Erosion Control: Filter X, Mirafi 100X, Stabilinka T140N or approved equivalent.
 - 3. Separation for Underdrains: Amoco 2002 & 2004, Contech Construction Products Inc. C-180, Synthetic Industries Geotex 250ST & 315ST, Mirafi Geolon HP570 & HP1500 or approved equivalent.
 - 4. ADS Geosynthetics 315WTM woven geotextile fabric.
 - 5. ADS Geosynthetics 601T non-woven geotextile fabric.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.

3.2 CLEARING AND GRUBBING

- A. Clear and grub the site within the grading limit line of trees, shrubs, brush, other prominent vegetation, debris, and obstructions except for those items indicated to remain. Completely remove stumps and roots protruding through the ground surface.
 - 1. Use only hand methods for grubbing inside the drip line of trees indicated to be left standing.

2. Where roots and branches of trees indicated to be saved interfere with new construction, carefully and cleanly cut them back to point of branching.
- B. Fill depressions caused by the clearing and grubbing operations in accordance with the requirements for filling and backfilling, unless further excavation is indicated.

3.3 REMOVAL OF TOPSOIL

- A. Remove existing topsoil from areas within the Grading Limit Line where excavation or fill is required.
- B. Stockpile approved topsoil where directed until required for use. Place, grade, and shape stockpiles for proper drainage.
 1. Topsoil will be tested prior to stockpiling. Stockpile only quantities of topsoil approved in writing for re-use.

3.4 UNDERGROUND UTILITIES

- A. Locate existing underground utilities prior to commencing excavation work. Determine exact utility locations by hand excavated test pits. Support and protect utilities to remain in place.
- B. Do not interrupt existing utilities that are in service until temporary or new utilities are installed and operational.
- C. Utilities to remain in service: Will be re-routed as shown on the Contract Drawings.
- D. Utilities abandoned beneath and five feet laterally beyond the structure's proposed footprint will be removed in their entirety. Excavations required for their removal will be backfilled and compacted as specified herein.
- E. Utilities extending outside the five feet limit specified above may be abandoned in place provided their ends are adequately plugged as described below.
 1. Permanently close open ends of abandoned underground utilities exposed by excavations, which extend outside the limits of the area to be excavated.
 2. Close open ends of metallic conduit and pipe with threaded galvanized metal caps or plastic plugs or other approved method for the type of material and size of pipe. Do not use wood plugs.
 3. Close open ends of concrete and masonry utilities with concrete or flow-able fill.

3.5 EXCAVATION

- A. Excavate earth as required for the Work.
- B. Install and maintain all erosion and sedimentation controls during all earthwork operations as specified on the Contract Drawings.

- C. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Comply with Code of Federal Regulations Title 29 - Labor, Part 1926 (OSHA).
 - 1. Trenches: Deposit excavated material on one side of trench only. Trim banks of excavated material to prevent cave-ins and prevent material from falling or sliding into trench. Keep a clear footway between excavated material and trench edge. Maintain areas to allow free drainage of surface water.
- D. Stockpile excavated materials classified as suitable material where directed, until required for fill. Place, grade, and shape stockpiles for proper drainage as approved by the Engineer.
- E. Excavation for Structures: Conform to elevations, lines, and limits indicated. Excavate to a vertical tolerance of ± 1 inch. Extend excavation a sufficient lateral distance to provide clearance to execute the work.
- F. Slabs and Floors: Excavate to the following depths below bottom of concrete for addition of select granular material:
 - 1. Interior Floors: 6 inches unless otherwise indicated.
 - 2. Exterior Slabs and Steps: 12 inches unless otherwise indicated.
- G. Pipe Trenches: Open only enough trench length to facilitate laying pipe sections. Unless otherwise indicated on the Drawings, excavate trenches approximately 24 inches wide plus the outside pipe diameter, equally divided on each side of pipe centerline. Cut trenches to cross section, elevation, profile, line, and grade indicated. Accurately grade and shape trench bottom for uniform bearing of pipe in undisturbed earth. Excavate at bell and coupling joints to allow ample room for proper pipe connections.
 - 1. Trench in Rock: Excavate an additional 6 inches below bottom of pipe for bed of cushion material under the piping.
- H. Open Ditches: Cut ditches to cross sections and grades indicated.
- I. Pavement: Excavate to subgrade surface elevation.
- J. Unauthorized Excavations: Unless otherwise directed, backfill unauthorized excavation under footings, foundation bases, and retaining walls with compacted select granular material without altering the required footing elevation. Elsewhere, backfill and compact unauthorized excavation as specified for authorized excavation of the same classification, unless otherwise directed by the Engineer.
- K. Notify the Engineer upon completion of excavation operations. Do not proceed with the work until the excavation is inspected and approved. Inspection of the excavation by the Engineer will be made on three (3) working days' notice.
- L. Removal of Unsuitable Material Beneath Structures and Other Improvements: Excavate encountered unsuitable materials, which extend below required elevations, to additional depth as directed by the Engineer. Have cross sections

taken to determine the quantity of such excavation. Do not backfill this excavation prior to quantity measurement.

3.6 DEWATERING

- A. Prior to the performance of any excavations provide dewatering methods such that the groundwater table is maintained at an elevation that is beneath the excavated depth.
- B. Prevent surface and subsurface water from flowing into excavations and trenches and from flooding the site and surrounding area.
- C. Do not allow water to accumulate in excavations or trenches. Remove water from all excavations immediately to prevent softening of undercutting footings, and soil changes detrimental to the stability of subgrades. Furnish and maintain pumps, sumps, suction and discharge piping systems, and other system components necessary to convey the water away from the Site.
- D. Convey water removed from excavations, and rain water, to collecting or run-off area. Cut and maintain temporary drainage ditches and provide other necessary diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
- E. Provide temporary controls to restrict the velocity of discharged water as necessary to prevent erosion and siltation of receiving areas.

3.7 SUBGRADE SURFACE FOR WALKS AND PAVEMENT

- A. Shape and grade subgrade surface as follows:
 - 1. Walks: Shape the surface of areas under walks to required line, grade and cross section, with the finish surface not more than 1 inch above or below the required subgrade surface elevation.
 - 2. Pavements: Shape the surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subgrade surface elevation.
- B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Thoroughly compact subgrade surface for walks and pavement by mechanical rolling, tamping, or with vibratory equipment as approved to the density specified.

3.8 PLACING GEOTECH FABRIC

- A. Place and overlap geotech fabric in accordance with the manufacturer's installation instructions, unless otherwise shown.
- B. Cover tears and other damaged areas with additional fabric layer extending three feet beyond the damage.

- C. Do not permit traffic or construction equipment directly on fabric.
- D. Backfill over fabric within two weeks after placement. Backfill in accordance with the fabric manufacturer's instructions and in a manner to prevent damage to the fabric.

3.9 PLACING FILL AND BACKFILL

- A. Surface Preparation of Fill Areas: Strip topsoil, remaining vegetation, and other deleterious materials prior to placement of fill. Remove all asphalt pavement in its entirety from areas requiring the placement of fill or break up old pavements to a maximum size of four inches. Prior to placement of fill, smooth out and compact areas where wheel rutting has occurred due to stripping or earthwork operations.
- B. Place backfill and fill materials in layers not more than eight inches thick in loose depth unless otherwise specified. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or covered with ice.
 - 1. Place fill and backfill against foundation walls, and in confined areas such as trenches not easily accessible by larger compaction equipment, in maximum six-inch-thick loose depth layers.
 - 2. For large fill areas, the layer thickness may be modified by the Engineer, at the Contractor's written request, if in the Engineer's judgment, the equipment used is capable of compacting the fill material in a greater layer thickness. This request will include the type and specifications of compaction equipment intended for use.
- C. Under Exterior Concrete Slabs and Steps:
 - 1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.
 - 2. Subbase Material: Place 12 inches of select granular material over subgrade surface.
- D. Under Pavements and Walks:
 - 1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.
 - 2. Subbase Material: Place as indicated.
- E. Landscaped Areas: Place suitable material when required to complete fill or backfill areas up to subgrade surface elevation. Do not use material containing rocks over four inches in diameter within the top 12 inches of suitable material.
- F. Plastic Pipe in Trenches: Place cushion material a minimum of six inches deep under pipe, 12 inches on both sides, and 12 inches above top of pipe. Complete balance of backfill as specified.
 - 1. Trench in Rock: Place a minimum six-inch-deep bed of cushion material under pipe.

- G. Backfilling Excavation Resulting From Removal of Unsuitable Material Beneath Structures and Other Improvements: Backfill the excavation with compacted select granular material.

3.10 COMPACTION

- A. All materials with exception of open graded stone:
 - 1. Compact each layer of fill and backfill for the following area classifications to the percentage of maximum density specified below and at a moisture content suitable to obtain the required densities, but at not less than three percent drier or more than two percent wetter than the optimum content as determined by ASTM D 698 (Standard Proctor) or 1557 (Modified Proctor).
 - a. Structures (entire area within ten feet outside perimeter): 95 percent.
 - b. Concrete Slabs and Steps: 95 percent.
 - c. Landscaped Areas: 90 percent.
 - d. Pavements and Walks: 95 percent.
 - e. Pipes and Tunnels: 95 percent.
 - f. Pipe Bedding: 95 percent.
 - 2. When the existing ground surface to be compacted has a density less than that specified for the particular area classification, break up and pulverize, and moisture condition to facilitate compaction to the required percentage of maximum density.
 - 3. Moisture Control:
 - a. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, and during compaction operations.
 - b. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.
 - 4. If a compacted layer fails to meet the specified percentage of maximum density, the layer will be recompacted and retested. If compaction cannot be achieved the material/layer will be removed and replaced. No additional material may be placed over a compacted layer until the specified density is achieved.

3.11 ROUGH GRADING

- A. Exterior Grading: Trim and grade area within the grading limit line and excavations outside the limit line, required by this Contract, to a level of 4 inches below the finish grades indicated unless otherwise specified herein or where greater depths are indicated. Provide smooth uniform transition to adjacent areas.

1. Slope cut and fill in transition areas, outside of the grading limit line, to meet corresponding levels of existing grades at a slope of 1 vertical to 2 horizontal unless otherwise indicated.
2. Landscaped Areas: Provide uniform subgrade surface within 1 inch of required level to receive topsoil thickness specified. Compact fill as specified to within three inches of subgrade surface. Remove objectionable material detrimental to proper compaction or to placing full depth of topsoil. If the top three inches of subgrade has become compacted before placement of topsoil, harrow or otherwise loosen rough graded surface to receive topsoil to a depth of three inches immediately prior to placing topsoil.

3.12 FINISH GRADING

- A. Uniformly grade rough graded areas within limits of the grading limit line to finish grade elevations indicated.
- B. Grade and compact to smooth finished surface within tolerances specified, and to uniform levels or slopes between points where finish elevations are indicated or between such points and existing finished grade.
- C. Grade areas adjacent to building lines so as to drain away from structures and to prevent ponding.
- D. Finish surfaces free from irregular surface changes, and as follows:
 1. Grassed Areas: Finish areas to receive topsoil to within one inch above or below the required subgrade surface elevations.
 2. Walks: Place and compact subbase material as specified. Shape surface of areas under walks to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.
 3. Pavements: Place and compact subbase material as specified. Shape surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.

3.13 MAINTENANCE AND RESTORATION

- A. Restore grades to indicated levels where settlement or damage due to performance of the work has occurred. Correct conditions contributing to settlement. Remove and replace improperly placed or poorly compacted fill materials.
- B. Restore pavements, walks, curbs, lawns, and other exterior surfaces damaged during performance of the work to match the appearance and performance of existing corresponding surfaces as closely as practicable.
- C. Water seeded areas as required until physical completion of the work.

3.14 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS

- A. Remove from property and dispose of excess and unsuitable materials, including materials resulting from clearing and grubbing and removal of existing improvements.
- B. Transport excess and unsuitable materials, including materials resulting from clearing and grubbing and removal of existing improvements, to spoil areas on property, and dispose of such materials as directed.
- C. Transport excess topsoil to areas on property designated by the Engineer. Smooth grade deposited topsoil.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: A qualified special inspector shall perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: A qualified geotechnical engineering testing agency shall perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.16 PROTECTION

- A. Protect graded areas from traffic and erosion, and keep them free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

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SECTION 312319 – DEWATERING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes construction dewatering.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 312000: Excavation and Fill.

1.3 SUBMITTALS

- A. Field quality-control reports.
- B. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before work begins.
- C. Record Drawings: Identify locations and depths of abandoned-in-place dewatering equipment.
- D. Shop Drawings: Submit drawings and diagrams, with all pertinent data, showing the dewatering system proposed for use. Indicate the spacing and location of wellpoints and reading wells, and location of header lines, pumps, valves, and discharge lines.

1.3 QUALITY ASSURANCE

- A. Qualifications: The work of this Section shall be performed by a firm experienced in wellpoint dewatering work. The firm shall have satisfactorily completed such work for at least 5 projects of comparable size.
- B. The dewatering system shall consist of equipment, appliances, and materials designed or suitable for controlling groundwater in construction work.

1.4 PROJECT CONDITIONS

- A. Blasting and the use of explosive materials will not be permitted.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.

2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.

3.2 INSTALLATION

- A. Install the dewatering system in accordance with approved shop drawings and as required by site conditions. Locate elements of the system to allow a continuous dewatering operation without interfering with the installation of any permanent project work.
 - a. Space well points or wells at intervals required to provide sufficient dewatering.
 - b. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATIONS

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - a. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

- b. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - c. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Maintain a careful check to detect any settlement in existing adjacent Work. Notify the Engineer of any signs of settlement. Establish settlement point benchmarks and take periodic readings when directed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations. Promptly repair damages to adjacent facilities caused by dewatering.

3.6 REMOVAL

- A. When the dewatering system is no longer required and when directed, dismantle and remove the system and all appurtenances from the site.

END OF SECTION 312319

SECTION 312513 – EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes:

1. Furnish, install, inspect, maintain, and remove soil erosion and sediment control measures during construction as shown on the Contract Documents prepared for this project.
2. Minimize the potential short-term adverse environmental impacts associated with construction activity in environmentally sensitive areas.
3. Assure the quantity and quality of stormwater runoff is not substantially altered due to construction activities.
4. Stabilize slopes and protect offsite areas by the installation and maintenance of stabilization and erosion control measures.
5. Dewatering operation procedure.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 312000: Excavation and Fill .

1.3 REFERENCE STANDARDS

- A. New York Standards and Specifications for Erosion and Sediment Control, NYSDEC, latest edition.
- B. NYSDEC: Reducing the Impacts of Stormwater Runoff for New Development, latest edition.
- C. NYSDEC Environmental Conservation Law, Article 17. Titles 7, 8 and Article 70.
- D. 6 NYCRR Parts 611 – 613 and all additions.
- E. OSHA 40 CFR Part 258 and all additions. New York State: Standards and Specifications for Erosion and Sediment Control, latest edition.

1.4 PROJECT CONDITIONS

- A. During construction conduct operations in such a manner as to prevent or reduce to a minimum any damage to any water body from pollution by debris, sediment, chemical or other foreign material, or from the manipulation of equipment and/or materials in or near a stream or ditch flowing directly to a stream. Any water which has been used for wash purposes or other similar operations which become polluted with sewage, silt, cement, concentrated chlorine, oil, fuels, lubricants, bitumens, or other impurities shall not be discharged into any water body.
- B. In the event of conflict between these specifications and the regulation of other Federal, State, or local jurisdictions, the more restrictive regulations shall apply.
- C. The Work shall consist of furnishing, installing, inspecting, maintaining, and removing soil and erosion control measures as shown on the contract documents or as ordered by the Director's Representative during the life of the contract to provide erosion and sediment control.
- D. Temporary structural measures provide erosion control protection to a critical area for an interim period. A critical area is any disturbed, denuded slope subject to erosion. These are used during construction to prevent offsite sedimentation. Temporary structural measures shall include check dams, construction road stabilization, stabilized construction entrance, dust control, earth dike, level spreader, perimeter dike/swale, pipe slope drain, portable sediment tank, rock dam, sediment basin, sediment traps, silt fence, storm drain inlet protection, straw/hay bale dike, access waterway crossing, storm drain diversion, temporary swale, turbidity curtain, water bars or other erosion control devices or methods as required.
- E. Permanent structural measures also control protection to a critical area. They are used to convey runoff to a safe outlet. They remain in place and continue to function after completion of construction. Permanent structural measures shall include debris basins, diversion, grade stabilization structure, land grading, lined waterway (rock), paved channel, paved flume, retaining wall, riprap, rock outlets, and stream bank protection or other erosion control devices or methods as required.
- F. Vegetative measures shall include brush matting, dune stabilization, grassed waterway, vegetating waterway, mulching, protecting vegetation, seeding, sod, straw/hay bale dike, stream bank protection, temporary swale, topsoil, and vegetating waterways.

- G. Biotechnical measures shall include wattling (live fascines, brush matting, brush layering, live cribwall, and branchpacking) vegetated rock gabions, live staking, tree revetment, and fiber rolls.
- H. Weekly inspections will be completed by the Engineer. Comply with and correct all deficiencies found as a result of these inspections. At the end of the construction season when soil disturbance activities will be finalized or suspended until the following spring, the frequency of the inspections may be reduced. If soil disturbance is completely suspended and the site is properly stabilized, a minimum of monthly inspections must be maintained. The stabilization activities must be completed before snow cover or frozen ground. If vegetation is required, seeding, planting and/or sodding must be scheduled to avoid die-off from fall frosts and allow for proper germination/establishment. Weekly inspections must resume no later than March 15.

1.5 DEFINITIONS

- A. Stabilized Construction Entrance: A stabilized pad of aggregate underlain with geo-textile where traffic enters a construction site to reduce or eliminate tracking of sediment to public roads.
- B. Dust Control: Prevent surface and air movement of dust from disturbed soil surfaces.
- C. Portable Sediment Tank: A compartmented tank to which sediment laden water is pumped to retain sediment before pumping the water to adjoining drainage ways.
- D. Sediment Basin: A barrier constructed across a drainage way to intercept and trap sediment.
- E. Sediment Traps: A control device formed by excavation to retain sediment at a storm inlet or other points of collection.
- F. Silt Fence: A barrier of geo-textile fabric installed on contours across the slope to intercept runoff by reducing velocity. Replace after 1 year.
- G. Storm Drain Inlet Protection: A semi-permeable barrier installed around storm inlets to prevent sediment from entering a storm drainage system.
- H. Straw/Hay Bale Dike: Intercept sediment laden runoff by reducing velocity. Replace after 3 months.

- I. Storm drain Diversion: The redirection of a storm drain line or outfall channel for discharge into a sediment trapping device.
- J. Temporary Swale: A temporary excavated drainage swale.
- K. Protecting Vegetation: Protecting trees, shrubs, ground cover and other vegetation from damage.
- L. Temporary Seeding: Erosion control protection to a critical area for an interim period. A critical area is any disturbed, denuded slope subject to erosion.
- M. Permanent Seeding: Grasses established and combined with shrubs to provide perennial vegetative cover on disturbed, denuded, slopes subject to erosion.
- N. Sod: Used where a quick vegetative cover is required.

1.6 SUBMITTALS

- A. Product Data: Manufacturer's catalog cuts, specifications and installation instructions.
- B. Contingency Action Plan for prompt remedial action in the event spillage of petroleum products or other pollutants should occur. Contingency Action Plan shall be submitted to the Engineer for acceptance prior to the start of construction.
- C. Name and location of all material suppliers.
- D. Certificate of compliance with the standards specified above for each source of each material.
- E. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Silt Fence:
 - 1. Mirafi, Envirofence 365 South Holland Drive, Pendergrass, Ga, 30567, (888) 795-0808, <http://www.tencategeo.us/en-us/>

2. Filter X.
 3. Stabilinka T140N.
 4. Approved equivalent.
- B. Filter fabric inlet protection.
- C. Stone and block inlet protection.
- D. Temporary filters for inlet protection.
- E. Hardwood staking material.
- F. Stone material.
- G. Dry Rip Rap:
1. NYSDOT Standard Specification Section 620.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Prior to any construction activities, install temporary erosion and sediment control barriers or measures as indicated on the Contract Drawings, per manufacturer's specifications
- B. The Contractor shall be required to protect and preserve existing trees and shrubs in areas designated on the Contract Drawings. Contractor shall replace any tree or shrubs damaged in kind to the satisfaction of the Owner.
- C. The Contractor shall contact the Engineer once the erosion and sediment control structures have been installed.
- D. Prior to commencement of construction, the Engineer shall conduct an assessment of the site and certify that the appropriate erosion and sediment control structures as shown on the Contract Drawings have been adequately installed and implemented.
- E. Staging of Earthwork Activities: All earthwork shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.
- F. Vegetation adjacent to or outside of access roads or rights-of-way shall not be damaged.
- G. The Engineer has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate temporary or permanent erosion measures to minimize

damage to property and contamination of watercourses and water impoundments. Under no circumstances will the area of erodible earth material exposed at one time exceed 5 acres. The Engineer may increase or decrease this area of erodible earth material exposed at one time as determined by their analysis of project, weather and other conditions. The Engineer may limit the area of clearing and grubbing and earthwork operations in progress commensurate with the Contractor's demonstrated capability in protecting erodible earth surfaces with temporary, permanent, vegetative or biotechnical erosion control measures.

- H. Schedule the work so as to minimize the time that earth areas will be exposed to erosive conditions. Provide temporary structural measures immediately to prevent any soil erosion.
- I. Provide temporary seeding on disturbed earth or soil stockpiles exposed for more than 7 days or for any temporary shutdown of construction. In spring, summer or early fall apply rye grass at a rate of 1 lb/ 1000 sq.ft. In late fall or early spring, apply certified Aroostook Rye at a rate of 2.5 lbs./ 1000 sq. ft. Apply hay or straw at a rate of 2 bales/ 1000 sq. ft. or wood fiber hydromulch at the manufacturer's recommended rate. Hay or straw shall be anchored.
- J. Provide temporary grading to facilitate dewatering and control of surface water.
- K. Coordinate the use of permanent controls or finish materials shown with the temporary erosion measures.
- L. After final stabilization has been achieved, temporary sediment and erosion controls must be removed. Areas disturbed during removal must be stabilized immediately.
- M. Disposal of spoil material shall not be in any flood plain, wetland, stream, brook, or sensitive environmental area. The Contractor shall dispose of spoils within staging areas and provide sediment control barriers accordingly.

3.2 CLEARING

- A. Tree trunks and roots, vegetation, and project debris shall not be buried on site.
- B. Staging areas (for storage of materials and stockpiles) shall be located as shown on the plans. Where areas must be cleared for staging area

temporary structures, provisions shall be made for regulating drainage and controlling erosion.

- C. All abandoned or useless objects including equipment, supplies, personal property, rubbish, (including those present prior to construction activities) should be removed from the project work area and properly disposed of in accordance with local, state, and federal regulations.

3.3 IMPLEMENTATION

- A. All erosion and sediment control devices must be maintained in working order until the site is stabilized. All preventative and remedial maintenance work, including clean out, repair, replacement, re-grading, re-seeding, or re-mulching, must be performed immediately.
- B. The Contractor shall, at the direction of the Engineer, use necessary methods to minimize erosion within access roads, especially in areas that drain to watercourse areas.
- C. Cuts, fills, and other disturbed areas will be maintained to prevent erosion until adequate vegetative/impervious cover is established.
- D. Water, resulting from dewatering operations that will reduce the quality of receiving waters shall not be directly discharged. The Contractor shall provide, install, and maintain sump pits where necessary to dewater operations as detailed on the plans. Stone used within the sump pits shall be washed clean stone. The Contractor shall provide, install and maintain dewatering bags, as deemed necessary to control sediment deposits at critical environmental areas. Lifting straps shall be placed under the unit to facilitate removal after use. Dewatering bags shall be placed on stabilized areas over grass. Discharge hose from pump shall be inserted a minimum of six inches and tightly secured with attached strap to prevent water from flowing out of the unit without being filtered. Water from dewatering operations shall be treated to eliminate the discharge of sediment and other pollutants to streams and watercourses. The unit shall be replaced when it is half full of sediment or when the sediment has reduced the flow rate of the pump discharge to an impractical rate. Remove and dispose of sediment and dewatering bag off-site.
- E. Silt fence, where identified on plans, shall be installed at down gradient locations to control sediment deposits off-site at critical environmental areas. The silt fence shall be staked (unless noted otherwise), anchored and set as per manufacturer's specifications. The silt fence shall be

inspected on a daily basis and after a rain fall event and repaired as necessary.

- F. A stabilized construction entrance shall be installed and maintained for vehicular access on and off site. The entrance shall be constructed of 2" stone, or approved equal, and shall have a minimum length of 50 feet. The condition of the entrance shall be inspected daily and repaired as necessary.
- G. Dust control shall be controlled by the use of water, or calcium chloride application. Water application shall be applied at a rate where mud is not produced. The rate of application of the calcium chloride shall not exceed Federal, State and Local application rates or manufactures recommendations. Dust control shall be applied on adjacent public streets.
- H. Dry rip-rap shall conform to the lines, grades and thicknesses indicated on construction plans. It shall be a well-graded mass of variable size stones with no areas of uniform size material. Align stones to obtain a close fit and to minimize voids. Fill spaces between stones with spalls of suitable size.
- I. Paved areas within access corridors and parking areas shall be swept on a regular basis (minimum twice per week) as needed to minimize sediment and dust tracked from the work area. Should sediment and dust be tracked off-site, Contractor shall be responsible for sweeping public streets.
- J. During the final site restoration, the Contractor shall remove all sediment and debris deposited in the temporary and permanent erosion and sediment control barriers or measures including but not limited to all culverts and drainage swales, at no additional cost to the Owner.
- K. When all disturbed areas are stable, all temporary erosion and sediment control measures shall be removed per the approval of the Engineer. The measures are temporary and shall be removed and the areas restored to its original condition when they are no longer required, at no additional cost to the Owner.
- L. The Contractor is fully responsible for maintaining, repairing, and protecting his work throughout the project, at no additional cost to the Owner, until the Owner accepts the work.

END OF SECTION 312513

SECTION 334100 – STORM UTILITY DRAINAGE PIPING

PART 1 – GENERAL

1.1 SUMMARY

- A. Under this section the Contractor shall provide all labor, equipment and material necessary to furnish, install and test all storm utility drainage pipe and fittings as shown on the Contract Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 312000: Excavation and Fill.
- C. Section 334900: Storm Drainage Structures.

1.3 PROJECT CONDITIONS

- A. Location of Sewers and Sewer Structures: The location, elevation, and grades of sewers and sewer structures are shown on the Contract Drawings and shall be adhered to as closely as possible. If during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.
- B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

1.4 SUBMITTALS

- A. Shop Drawing: Pipes and associated fittings.
- B. Product Data: Manufacturer's specifications, including dimensions, allowable height of cover information, and installation instructions.
- C. Manufacturer's product literature, installation instructions and shop drawings for infiltration systems.

- D. As-built record drawings at project closeout of installed storm sewerage piping and products. An as-built survey prepared by licensed NYS Surveyor depicting the installed storm sewer piping and structures including rim and invert elevations of structures pipe size, pipe type, and invert of all piping. Both hard copy and electronic copy shall be provided to the Owner and Engineer.

1.5 QUALITY ASSURANCE

- A. Comply with standards of the Chain Link Fence Manufacturer's Institute.
- B. Provide steel fence and related gates as a complete compatible system including necessary erection accessories, fittings, and fastenings.
- C. Posts and rails shall be continuous without splices.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of the General Conditions.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate with other utility work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Corrugated Polyethylene Pipe (HDPE, Dual Wall with Smooth Interior): Conform to AASHTO M-294.
 - 1. Classification: Soil-tight, integral bell and spigot joints. Joints shall be sealed with factory-installed rubber O-ring gaskets that meet ASTM F-477.

2. Coefficient of Roughness (interior pipe surface): 0.012 maximum (Manning formula).
 3. Joint Couplings (Soil-tight): Polyethylene, bell-and-spigot type couplers utilizing an elastomeric gasket conforming to ASTM F-477.
 4. Fittings:
 - a. High density polyethylene meeting the properties specified for the pipe.
 - b. Either molded or fabricated.
 - c. Designed specifically for the pipe furnished and manufactured by the pipe manufacturer.
 5. Acceptable Manufacturer:
 - a. ProLink ST (N-12 IB ST), Smooth Interior Pipe & Fittings by Advanced Drainage Systems, Inc., (ADS) 3300 Riverside Dr., Columbus, OH 43221; (614) 457-3051
 - b. Approved equivalent.
- B. High Density Polyethylene Pipe (HDPE) Perforated Pipe: Perforated double wall smooth interior pipe complying with the following:
1. 4" to 10" diameter pipe to conform to AASHTO M 252.
 2. 12" to 36" diameter pipe to conform to AASHTO M 294
 3. Coefficient of Roughness (Interior Pipe Surface): 0.012 maximum (Manning Formula).
 4. Classification: Type S
 5. Joint Couplings: Polyethylene, bell and spigot type couplers utilizing an elastomeric gasket conforming to ASTM F 477. Snap on type or split collar through 24" diameter.
 6. Corrugated to match pipe corrugations, width not less than one half the pipe diameter.
 7. Split couplings shall engage an equal number of corrugations on each side of the joint.
 8. Fittings: Either molded or fabricated, high density polyethylene components meeting the properties specified for, and designed specifically for the pipe manufactured by the pipe manufacturer.
 9. Perforated Pipe: Conform to AASHTO M-252 or AASHTO M-294, Type SP with Class I perforations.
 10. Specifications have been based on products manufactured by Advanced Drainage Systems, Inc, Columbus, Ohio (Tel. #614-457-3051) or Hancor, Inc., Findlay, Ohio (Tel. #800-847-5880).
- C. Polyvinyl Chloride (PVC) Pipe for in-line drain piping, solid: Conform to ASTM D-3034 and ASTM F1336 (SDR-35)

1. Conform to shape, dimensions, and thickness shown on the Contract Drawings.
2. Provide fittings of the same size and pressure rating as the pipe to which they are connected.
3. Rubber gasketed joints manufactured in accordance with ASTM D-3139.
4. Rubber gaskets shall comply with ASTM D3212 Internal Pressure Test and Vacuum Test at 5 degrees of gasket joint deflection.
5. AdvanEdge Pipe and Couplings, as manufactured by Advanced Drainage Systems, Inc., (ADS) 3300 Riverside Dr., Columbus, OH 43221; (614) 457-3051, or approved equivalent.

2.2 GEOTECHNICAL FABRIC

A. Filter Fabric (GeoTextile):

1. Separation for Underdrains: Amoco 2002 & 2004, Contech Construction Products Inc. C-180, Synthetic Industries Geotex 250ST & 315ST, Mirafi Geolon HP570 & HP1500 or approved equivalent.

PART 3 – EXECUTION

3.1 MAINTENANCE OF EXISTING STORMWATER FLOWS

- A. Provide all temporary facilities required to safely and adequately bypass existing stormwater flows from the Work area during construction.
- B. The bypassing of such flows shall prevent any hazards to public health and welfare when the stormwater flows are bypassed from the Work area during construction.
- C. The Contractor is fully responsible for any and all damages to construction, adjacent properties, utilities, and/or buildings in the area caused by these operations.

3.2 INSPECTION

- A. Inspect pipe and fittings before installation. Remove defective materials from the Site.
- B. Concrete pipes shall be free from fractures, cracks, and surface roughness.

- C. Pipe with damaged ends will not be accepted when such damage would prevent making a satisfactory joint.

3.3 INSTALLATION

- A. General Locations and Arrangements: Contract Drawings (plans and details) indicate the general location and arrangement of the underground storm sewerage system piping. Location and arrangements of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical. If, during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes or catch basins for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- F. Extend storm sewerage system piping to connect to building storm drains, of sizes and in locations indicated.
- G. Fill excess excavation with suitable materials and tamp.

3.4 STORM SEWER RELATION TO WATER LINE

- A. Horizontal Separation: Storm sewers should be laid at least 10 feet, horizontally, from any existing or proposed water line.
- B. Vertical Separation: Whenever sewers must cross water line, the storm sewer shall be laid at such so there is an 18-inch vertical separation

between the two lines. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with push-on joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

- C. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main should be constructed of a slip-on or mechanical-joint ductile iron pipe, and the sewer constructed of mechanical-joint ductile iron pipe and both pressure-tested to assure water tightness.

3.5 PROTECTING PIPE

- A. During the progress of the Work keep pipe clean from all sediment, debris, and other foreign material.
- B. Close all open ends of pipes and fittings securely with removable plugs at end of Work day, during storms, when the Work is left at any time, and at such times as Engineer may direct.

3.6 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000-psi 28-day compressive-strength concrete.
- C. Make branch connections from side into existing 4- to 21-inch piping by removing section of existing pipe and installing wye fitting, into existing piping. Encase entire wye with not less than 6 inches of 3000-psi 28-day compressive-strength concrete or,
- D. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless

otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Provide concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
 - a. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.7 FIELD QUALITY CONTROL

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 3. Flush piping between manholes, if required by local authority, to remove collected debris.
- B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 1. Make inspections of pipe between manholes/fittings, after pipe has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and re-inspect.
- C. Water Tightness of Sewer Structures: It is the intent of the Contract Drawings and these Specifications that the completed storm sewer lines shall be as watertight and free from infiltration as practical, unless specified otherwise. All visible leaks or points of infiltration shall be repaired.

END OF SECTION 334100

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SECTION 334900 – STORM DRAINAGE STRUCTURES

PART 1 – GENERAL

1.1 This Section includes:

- A. Under this section the Contractor shall provide all labor, equipment and material necessary to furnish, install and test all storm utility drainage structures and fittings as shown on the Contract drawings, specified herein and approved by the Engineer.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 312000: Excavation and Fill.
- C. Section 334100: Storm Drainage Piping.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO).
- B. American Society for Testing and Materials (ASTM).

1.4 PROJECT CONDITIONS

- A. Location of Sewers and Sewer Structures: The location, elevation, and grades of sewers and sewer structures are shown on the Contract Drawings and shall be adhered to as closely as possible. If during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.
- B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system may be installed in compliance with original design and referenced standards.

1.5 SUBMITTALS

- A. Shop drawings for precast concrete storm drainage structures, including cast iron frames, grates, covers, precast dry well and infiltrator system components. Submittal shall include installation, inspection and maintenance instructions for the infiltration system.
- B. Product Data: Manufacturer's catalog cuts, specifications, and installation instructions. And manufacturer's certificates.
- C. As-built record drawings at project closeout of installed storm sewerage piping and products. An as-built survey prepared by licensed NYS Surveyor depicting the installed storm sewer piping and structures including rim and invert elevations of structures pipe size, pipe type, and invert of all piping. Both hard copy and electronic copy shall be provided to the Owner and Engineer.

1.6 QUALITY ASSURANCE

- A. Manufacturer data: All products must be produced by a facility that demonstrates five (5) years of experience in the production of similar products.
- B. All material utilized in construction of structures shall comply with all applicable ASTM and NYSDOT standards.
- C. Environmental Compliance: Comply with applicable portions of local health department and environmental agency regulations pertaining to storm sewerage systems.
- D. Utility Compliance: Comply with local utility regulations and standards pertaining to storm sewerage.
- E. All storm sewer system components shall be installed in accordance with applicable plumbing code requirements and in accordance with all license requirements.
- F. All storm sewer construction shall be subject to inspection by the Engineer prior to backfilling.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall check all materials upon delivery to assure that the proper materials have been received.

- B. Contractor shall check the structures for shipping damage prior to installation. Units that have been damaged must not be installed. Contractor shall contact manufacturer immediately upon discovery of any damage.
- C. All material shall be delivered to the site and unloaded with handling that conforms to the manufacturer's instructions for reasonable care.
- D. Protect material from dirt and damage.
- E. All material shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of the structure on the job shall be in accordance with the manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Precast Rectangular Reinforced Concrete Drainage Structures:
 - 1. Structure shall be manufactured by the Fort Miller Co. Inc. or approved equivalent.
 - 2. Structure shall be designed for HS20-44 vehicular loading plus 25% impact.
 - 3. Riser Sections: ASTM C 478.
 - 4. Joints Between Riser Sections - One of the following:
 - a. Rubber Gaskets: ASTM C-443.
 - b. Butyl Joint Sealant: ConSeal CS-202 by Concrete Sealants, Inc., or approved equivalent.
 - 5. Concrete for Precast Units: Air content 6% by volume with an allowable tolerance of 1.5% +/- . Minimum compressive strength of 4,500 PSI after 28 days.
 - 6. Concrete Reinforcement: Reinforcement for structure shall be designed by a Licensed New York State Professional Engineer prior to construction.
 - a. Welded Wire Fabric: ASTM A 185.
 - b. Steel Bars: ASTM A 615, Grade 60.
 - 7. Steps:
 - a. Reinforced Plastic: 1/2-inch steel reinforced (ASTM A-615, Grade 60) polypropylene, or other plastic material complying with NYSDOT 725-02.01.

- b. Capable of withstanding a 300 lb. concentrated live load without permanent distortion and with rungs a minimum 10 inches wide designed to prevent feet from slipping off the ends.
 - c. Manufactured by MA Industries or approved equivalents.
- B. Precast Square Reinforced Concrete Drainage Structure
 - 1. Structure shall be manufactured by the Fort Miller Co. Inc. or approved equivalent.
 - 2. Structure shall be designed for HS20-44 vehicular loading plus 25% impact.
 - 3. Structure shall have integral base.
 - 4. Riser Sections: ASTM C 890, height and width as indicated on the Contract Documents.
 - 5. Concrete for Pre-Cast Units: Air content 6% by volume with an allowable tolerance of +/-1.5%. Minimum compressive strength of 4,500 psi after 28 days.
 - 6. Pre-Cast Concrete Structure Load Rating: AASHTO HS-20 with 30% impact and 130 lb/cf equivalent soil pressure.
 - a. Casting Load Rating: AASHTO H20 wheel loading requirements. Manufacture, workmanship and certified proof-load tests shall conform to AASHTO M306-89 Standard Specification for Drainage Structure Castings.
 - b. Coatings: Minimum one shop coat of asphaltum to be applied to all frame and grate surfaces.
 - c. Acceptable Casting: As indicated on Contract Drawings.
- C. Frames, Grates, and Covers for Precast Reinforced Concrete Drainage Structures:
 - 1. Style: Heavy-Duty Frame and Grate Assembly.
 - 2. Size: 30" x 48".
 - 3. Frame and Grate: Provide castings of uniform quality, free from blow holes, porosity, hard spots, shrinkage defects, cracks or other injurious defects. Manufacture all castings true to pattern and free from surface imperfections. Provide heavy duty frames and grates with machined horizontal bearing surfaces.
 - 4. Design of each shall be the same throughout the project unless otherwise specified or indicated on the Contract Drawings.
 - 5. Units shall meet AASHTO HS20-44 vehicular loading plus 25% impact. Manufacturer, workmanship and certified proof-load tests shall conform to AASHTO M306-89-Standard Specification for Drainage Structure Castings.
 - 6. A.D.A. and Bicycle compliant.
 - 7. Material:
 - a. Cast iron: ASTM A48, Class 30B or 35B.

- b. Delivered to site free of any coatings, unless otherwise specified.
- F. Basin and Grate for Yard Inlet Basins:
 - 1. In-Line Drain and Grate: As manufactured by Nyloplast-ADS or equivalent, 13.5" by 13.25" in-line drain with cast iron HS20-44 rated grate.
 - 2. Grate: Round domed ductile iron model 1899CGD and 0899CGD by NYLOPLAST, or approved equivalent.
 - 3. Acceptable Drainage Structure Basin and Grate: Pattern 1899CGD and 0899CGD by NYLOPLAST, or approved equivalent.
- G. Frame, Grate, and Cover for Storm Manholes:
 - 1. Heavy Duty, Round Frame and Grate or Frame and Cover Assembly
 - 2. Size: 24" diameter
 - 3. Grates shall be A.D.A. and Bicycle compliant.
 - 4. Material:
 - c. Cast iron: ASTM A48, Class 30B or 35B.
 - d. Delivered to site free of any coatings, unless otherwise specified.
- H. Pipe-to-Drainage Structure Connection:
 - 1. Non-shrink cement mortar, ASTM C 270, Type M.
 - 2. Concrete Coating: Waterborne, non-flammable, VOC Compliance, 3 mil dry film thickness, cationic asphalt emulsion (55% - 60% petroleum asphalt), PGS 96 by Pipe Gasket & Supply Co., 2701 South Coliseum Boulevard, Suite 1010, Fort Wayne, Indiana, 46003, (219) 426-4575, or approved equivalent.
- I. Materials for use in mortar shall conform to the following requirements:
 - 1. Cement: Cement shall conform to the Standard Specifications for Portland Cement, ASTM Serial Designation C150 with latest amendments.
 - 2. Sand: Sand shall be sharp, clean, free from deleterious substances and shall be uniformly graded and shall conform to the "Standard Specification for Aggregate for Masonry Mortar", ASTM C144 with the latest amendments.
 - 3. Water: Water used in making mortar or concrete shall be clean and free from oil, alkali, sugar or other deleterious substances. When potable water is in reach, no other water shall be used.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Construct structures with precast reinforced riser sections to the dimensions shown on the Contract Drawings. Seal joints between precast riser sections with material specified. Install steps 12 inches o.c. from top to bottom and in a manner capable of withstanding a lateral pull of 1,000 lbs.
- B. Position tops of structures flush with finished grade.
- C. All lifting holes shall be sealed by driving a tapered rubber plug into hole and filling the remaining void with a non-shrink grout.
- D. Cast iron frames, grates and covers shall be set to the proper elevation in a full bed of mortar. The frame shall be completely mortared onto the manhole as shown on the Contract Drawings.
- E. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of existing structures and construction to remain. Strengthen or add new supports when required during progress of selective demolition.

3.2 BRICK TO BRING STORM DRAINAGE STRUCTURE TO GRADE

- A. Brick shall be used in conjunction with precast concrete spacers to bring frames to grade for heights under twelve (12) inches in the following manner:
 - 1. Bricks shall be thoroughly wet when used and each brick shall be laid in a full bed of mortar including side and end joints. Normal 3/8-inch joints shall be used except when the brick is laid radially, in which case the narrowest part of the joint will not exceed 1/4 inch. Brick shall be laid neatly with sufficient width to adequately support the cast iron frame. The entire stack shall be completely plastered on the exterior side when initially constructed. The brick work shall be kept moist for a period of five (5) days after completion and adequately protected to prevent freezing during cold weather. The interior of the brick shall be neatly plastered once final grading and paving is completed so that the frame and cover will not be disturbed by additional work.

3.3 FIELD QUALITY CONTROL

- A. Cleaning: Clear interior of structures of dirt and other superfluous material as work progresses.
- B. Flush piping between manholes, if required by local authority, to remove collected debris.

- C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
- D. Make inspections of pipe between manholes/fittings, after pipe has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
- E. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and re-inspect.
- F. Water Tightness of Storm Sewer Structures: It is the intent of the Contract Drawings and these Specifications that the completed storm sewer structure shall be as watertight and free from infiltration as practical. All visible leaks or points of infiltration shall be repaired.

END OF SECTION 334900

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